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Cordeiro, N.J. & Githiru, M. 2000. Conservation evaluation for birds of *Brachylaena* woodland and mixed dry forest in north-east Tanzania. *Bird Conservation International* 10: 47–65.

Stuart, S.N., Jensen, F.P., Brøgger-Jensen, S. & Miller, R.I. 1993. The zoogeography of the montane forest avifauna of eastern Tanzania. Pp. 203–228 *in* Lovett, J.C. & Wasser, S.K. (eds) *Biogeography and ecology of the rainforests of Eastern Africa*. Cambridge: Cambridge University Press.

(continued on inside back cover)

Scopus 21: 1–14, July 2001

Avifauna and vegetation of the Shume *Juniperus* forest in the West Usambara mountains, Tanzania

Jon C. Lovett and Simon N. Stuart

The West Usambara mountains, Tanzania (04°30′ S, 38°20′ E) are a large upland block of ancient crystalline gneiss rising to nearly 2300 m and covering about 2200 km². They are 70 km from the Indian Ocean and less than 5 degrees south of the equator, and so have an oceanic climate with a bimodal rainfall peaking in November and April, the wettest areas receiving 2000 mm mean annual rainfall a year. Moist forest occurs from 150–2285 m altitude and covers extensive areas of the wetter eastern, southern, and northern sides of the mountain (Figure 1). Of the total forest area of 24,532 ha, less than 2% is below 1065 m (van der Willigen & Lovett 1979).

The western side of the mountain in the rainshadow is considerably drier than the other sides, and the vegetation changes accordingly, becoming woodland, thicket, and scrub. However, at higher altitudes between 1890 and 2070 m in the west and central area a distinctive low-canopy forest occurs associated with *Juniperus procera* (East African Pencil Cedar). At one time this vegetation type was extensive, covering more than 15,000 ha, but is now reduced to a heavily disturbed remnant of 1293 ha (Figure 2) following replacement of natural forest by pine plantations, and the excision of 12,000 ha of Shume-Magamba forest reserve in 1963 for local cultivation (Lundgren 1978).

This paper is based on work carried out in 1979, 1980 and 1983 in the Shume *Juniperus* forest and at two sites in the adjacent Shume-Magamba forest at 2100 m and 1800 m altitude. A short review of vegetation and climate in each of the sites is given, followed by methods used in the study and a discussion of the results in relation to forest classification and conservation.

Vegetation and climate

The Shume *Juniperus* forest canopy is irregular at between 10 to 20 m and there is extensive grass cover on the forest floor. *Juniperus procera* is the tallest tree, with large individuals reaching 30 m. Other trees over 20 m include *Warburgia ugandensis* ssp. *ugandensis*, *Calodendrum eickii*, *Rawsonia lucida*, *Trichocladus ellipticus* and *Diospyros natalensis*. Although *Juniperus procera* is the most easily recognised tree, the commonest tree is *Catha edulis*. The forest

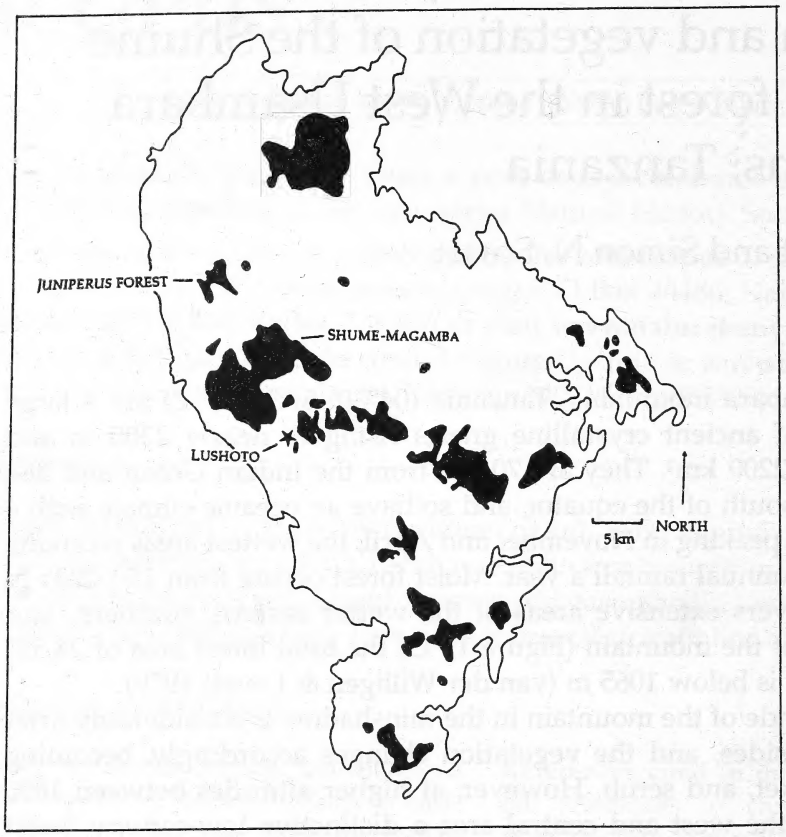

Figure 1. Map of the West Usambara mountains, with forest in black (from Lovett & Van der Willigen 1979).

is classified as 'Cedar' (*Juniperus*) forest by Moreau (1935) and Pitt-Schenkel (1938). A check-list of plants occurring in the Usambara mountains and a review of forest conservation have been published by Iversen (1991a, 1991b). The soils and plantations at Shume are described by Lundgren (1978), and an account of biological values of the Usambara forests is given by Rodgers & Homewood (1982).

The Shume-Magamba sites are rather different to the *Juniperus* forest. The 2100 m site (38°15′ E, 4°42′ S) is on top of a ridge, with a combination of closed canopy forest and open areas with *Erica*. The forest is composed mostly of small diameter poles and has a low canopy 12–15 m high with *Polyscias stuhlmannii, Aphloia theiformis, Trichocladus ellipticus* and *Macaranga kilimandscharica*. The shrub layer is composed mostly of Rubiaceae, and the herb layer of ferns. The 1800 m site (38°15′ E, 4°44′ S) is on a valley side below Grewall's saw mill in Shume Nature Reserve and has a canopy 30–40 m high with emergents to 60 m, a well developed, diverse mid-storey, a shrub layer dominated by Rubiaceae and a herb layer dominated by *Isoglossa lactea*. Canopy trees include *Chrysophyllum gorungosanum, Podocarpus falcatus* and *Ocotea usambarensis*.

Annual rainfall means for six different rainfall stations around the *Juniperus* forest are given in Table 1. Total rainfall varied considerably from

year to year, with years of high and low rainfall being similar in most of the stations. Monthly rainfall shows the bi-modal rainfall pattern characteristic of the Usambara mountains, with peaks in November–December and March–April. There is a marked dry season from June to September. Light frosts occur occasionally during the cold season in June and July (Moreau 1935, Pitt-Schenkel 1938, Lundgren 1978). The Mlomboza station gives the rainfall for the 2100 m site, and the rainfall at the 1800 m site can be estimated from a rainfall station at Grewall's sawmill which has an annual rainfall of around 1100 mm (Lundgren 1978).

Methods

Woody vegetation was assessed using two methods. In both the *Juniperus* forest and Shume-Magamba 1800 m site, five variable area plots were enumerated in which the nearest twenty trees to an objectively chosen point of greater than or equal to 20 cm diameter at breast height (dbh) were measured, and identified (Hall 1991). Half way between the 20th tree and

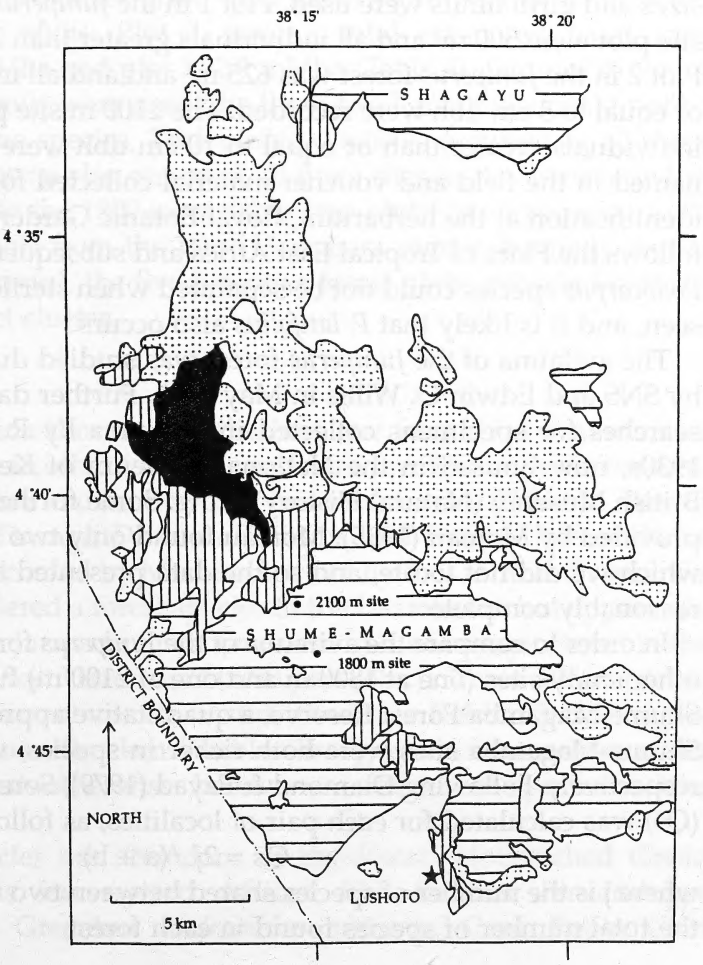

Figure 2. Map of the West Usambara *Juniperus* forest and surrounding area. the *Juniperus* forest is marked in black. Natural moist forest existing in 1976 is marked by horizontal lines. Areas deforested between 1954 and 1976 are stippled. Derived from Tanga Integrated Rural Development Programme (TIRDEP) airphoto interpretation project.

Table 1. Number of years of records, mean annual rainfall, and standard deviation of rainfall data from six rainfall stations around the Shume *Juniperus* forest

Rainfall station	No. of years of observations	Mean annual rainfall ± s.d. (mm)
Shume Forest Station	21	723 ± 134
Gologolo Nursery	18	974 ± 226
Gologolo Forest House	15	816 ± 155
Mlomboza	12	892 ± 234
Manolo	9	546 ± 96
Lukosi Forest Station	4	638 ± 184

the 21st tree was taken as the plot radius, enabling density and basal area estimates to be made. This method has been used extensively in the West Usambaras (Lovett 1992) and so direct comparisons between the *Juniperus* forest and other areas were possible. This was done using a reciprocal averaging method of ordination (Hill 1973). The second method was to enumerate subjectively positioned fixed area plots. Several different plot sizes and girth limits were used. Plot 1 in the *Juniperus* forest and the 1800 m site plot were 500 m^2 and all individuals greater than 2 m tall were recorded. Plot 2 in the *Juniperus* forest was 625 m^2 and and all individuals greater than or equal to 3 cm dbh were recorded. The 2100 m site plot was 256 m^2 and all individuals greater than or equal to 10 cm dbh were recorded. Plants were named in the field and voucher material collected for confirmation of their identification at the herbarium, Royal Botanic Gardens, Kew. Nomenclature follows the Flora of Tropical East Africa and subsequent taxonomic revisions. *Podocarpus* species could not be separated when sterile; *P. falcatus* fruits were seen, and it is likely that *P. latifolius* also occurs.

The avifauna of the *Juniperus* forest was studied during a visit to the area by SNS and Edwin O. Willis in May 1981. Further data were gathered from searches for specimens collected in this area by R.E. Moreau during the 1930s, now housed in the National Museum of Kenya, Nairobi, and the British Museum (Natural History) Tring. Some further information was also provided by Moreau (1935). Moreau found only two species in these forests which we did not locate, and so the data presented here can be considered reasonably complete.

In order to compare the avifauna of the *Juniperus* forest with those of SNS's other study sites (one at 1800 m and one at 2100 m) further to the east in the Shume-Magamba Forest Reserve, a quantitative approach was adopted. The Shume-Magamba sites were both richer in species, with 55 and 46 species respectively. Following Diamond & Fayad (1979), Sørensen's Similarity Index (Qs) was calculated for each pair of localities, as follows:

$$Qs = 2j / (a + b)$$

where j is the number of species shared between two forests, and a and b are the total number of species found in each forest.

Results

Vegetation

The total area of the five variable area plots in the *Juniperus* forest was 0.54 ha, and the total basal area of the trees enumerated was estimated to be 8.3 m^2 (calculated from the diameter at breast height, assuming each tree to be circular in cross section), giving a basal area of 15.4 m^2/ha. Of the 100 trees enumerated 55% were *Catha edulis*, contributing 45.4% of the basal area. *Juniperus procera* contributed 14% of the individuals and 25.5% of the basal area. *Euphorbia* sp. only occurred in one plot, but contributed 10% of the individuals and 10.9% of the basal area, indicating that this species occurs in clumps (Table 2). The remaining eight species contributed 21% of the individuals and 18.2 % of the basal area. The five Shume Magamba variable area plots covered an area of 0.41 ha, with a basal area of 30 m^2, or 73.2 m^2/ha. *Ocotea usambarensis* contributed 22% of the individuals and 55.1% of the basal area, and was co-dominant with *Podocarpus* which contributed 19% of the individuals and 15.4% of the basal area (Table 3). Only *Catha edulis* occurred in both the *Juniperus* forest and 1800 m site plots.

The Shume *Juniperus* forest fixed-area plots again demonstrated the dominance of *Catha edulis*. Plot 1 gave a total estimated basal area contribution of 1.6 m^2/ha and plot 2, 2.9 m^2/ha (Table 4). Because different plot sizes and girth limits were used, the three fixed-area plots could not be compared directly. One species, *Trichocladus ellipticus*, occurred in all three plots. *Cassipourea malosana* also occurs in all three sites as it was recorded in the 2100 m plot, and in the 1800 m variable area plots. In comparison to 88 other variable area plots from the West Usambara mountains (only one of which contained *Juniperus*), the five *Juniperus* forest plots ordinated entirely separately as a distinct cluster.

Birds

Analysis of the avifauna showed that the *Juniperus* forest bird communities are distinct from those in other forest formations a few kilometres to the east. Only 35 bird species are known from the *Juniperus* forests (Table 5). Two of these, the Common Drongo *Dicrurus adsimilis* and Retz's Helmet-shrike *Prionops retzii*, were recorded by Moreau, but not by us. Of these *D. adsimilis* is not normally considered a forest species in the Usambaras, but apparently behaves as such in the *Juniperus* forest (and also in the Shagayu Forest in the extreme north of the West Usambaras (SNS pers. obs.)). Three other species, the Scaly Francolin *Francolinus squamatus*, the Cape Robin Chat *Cossypha caffra*, and the Cinnamon Bracken Warbler *Bradypterus cinnamomeus*, occur within the forest, but otherwise behave as non-forest species in the Usambaras.

The following species are abundant in the forest: Moustached Green Tinkerbird *Pogoniulus leucomystax*, African Hill Babbler *Pseudoalcippe abyssinica*, Mountain Greenbul *Andropadus nigriceps*, Cape Robin Chat

Table 2. Results of *Juniperus* forest variable area plots (100 trees of 11 species enumerated in 5 plots covering 0.54 ha; total basal area 8.3 m^2 and basal area/ha 15.4 m^2)

Species	No. individuals	No. plots	Basal area cm^2	% basal area
Catha edulis	55	5	37802	45.4
Juniperus procera	14	4	21241	25.5
Euphorbia sp.	10	1	9048	10.9
Psydrax schimperiana	6	4	5988	7.2
Euclea divinorum	7	3	3259	3.9
Mystroxylon aethiopicum	2	2	2463	3.0
Olea europea	2	2	1749	2.1
Cassipourea malosana	1	1	511	0.6
Canthium mombazense	1	1	398	0.5
Ptaeroxylon obliquum	1	1	434	0.5
Diospyros natalensis	1	1	346	0.4

Cossypha caffra, Spot-throat *Modulatrix stictigula*, White-starred Robin *Pogonocichla stellata*, Black-headed Apalis *Apalis melanocephala*, Bar-throated Apalis *A. thoracica*, Evergreen Forest Warbler *Bradypterus lopezi*, Cinnamon Bracken Warbler *B. cinnamomeus*, Red-capped Forest Warbler *Orthotomus metopias*, African Dusky Flycatcher *Muscicapa adusta*, Black-backed Puffback *Dryoscopus cubla*, Fülleborn's Black Boubou *Laniarus fuelleborni*, Black-fronted Bush-shrike *Malaconotus multicolor*, Eastern Double-collared Sunbird *Nectarinia mediocris* and Red-faced Crimson-wing *Cryptospiza reichenovii*.

Other species seem to be much rarer, and the scarce Usambara Ground Robin *Sheppardia montana* and Usambara Weaver *Ploceus nicolli*, both known from the moister forest three kilometres to the east, are apparently absent. Non-forest species recorded in the cattle-grazed clearings include Speckled Mousebird *Colius striatus*, Malachite Sunbird *Nectarinia famosa* and Streaky Seed-eater *Serinus striolatus*, while Scarce Swift *Schoutedenapus myoptilus* is common. Moreau (1935) records Namaqua Dove *Oena capensis* and Red-cheeked Cordon-bleu *Uraeginthus bengalus* from this area, non-forest species unknown elsewhere in the Usambaras. There are no recent records of either species. Stuart & Jensen (1981) recorded the Rufous-breasted Sparrowhawk *Accipiter rufiventris* from the *Juniperus* forest, but this was later discovered to be a misidentification of the African Goshawk *Accipiter tachiro*.

The two sites in the Shume-Magamba Forest Reserve had extremely similar avifaunas (Qs = 0.911), whereas the *Juniperus* forest was relatively distinct, being marginally more similar to the study site at 2100 m in Shume-Magamba (Qs = 0.716) than to the site at 1800 m (Qs = 0.667).

Discussion

The *Juniperus* forest large tree associations are markedly different from the surrounding moister forest types, as demonstrated by ordination analysis. The basal area and species diversity are also low compared to the other West Usambara forests. The *Juniperus* forest plots have a basal area of 15.4 m^2/ha and an average of 5 species/plot. In contrast, the Shume-Magamba 1800 m plots have a basal area of 73.2 m^2/ha and an average of 9 species/plot. In other variable area plots in the West Usambara mountains, upper montane forest has an average basal area of 54.5 m^2/ha, with 9 species/plot; montane forest has an average basal area of 61.9 m^2/ha with 10 species/plot; and submontane forest has an average basal area of 48.4 m^2/ha with 10 species/plot (Lovett 1992).

The avifauna of the *Juniperus* forest is also distinct from other forest bird communities in the Usambaras. This difference appears to lie in the absence

Table 3. Results of Shume-Magamba variable area plots (100 trees of 22 species enumerated in 5 plots covering 0.41 ha; total basal area 30.0 m^2 and basal area/ha 73.2 m^2)

Species	Number of individuals	Number of plots	Basal area cm^2	% basal area
Ocotea usambarensis	22	5	165521	55.1
Podocarpus	19	5	46191	15.4
Nuxia congesta	7	4	27333	9.1
Drypetes gerrardii	7	3	19612	6.5
Dasylepis integra	7	3	5616	2
Trichocladus ellipticus	9	3	5200	1.7
Albizia gummifera	1	1	4536	1.5
Pouteria adolfi-friedericii	1	1	4301	1.4
Chrysophyllum gorungosanum	1	1	4072	1.3
Vepris stolzii	3	2	3036	1
Rapanea melanophloeos	4	3	2926	1
Syzygium sclerophyllum	2	1	1704	0.6
Psydrax parviflora ssp. *rubrocostata*	3	2	1604	0.5
Cassipourea malosana	2	1	1455	0.5
Catha edulis	1	1	1452	0.5
Olea capensis	1	1	1320	0.4
Casearia englerii	3	2	1296	0.4
Tabernaemontana pachysiphon	2	2	1190	0.4
Dombeya torrida ssp. *erythroleuca*	2	2	660	0.2
Macaranga kilimandscharica	1	1	616	0.2
Polyscias stuhlmannii	1	1	471	0.2
Cryptocarya liebertiana	1	1	346	0.1

Table 4. Percentage basal area contributions of the species enumerated in the fixed area plots, arranged in order of cumulative basal area contribution. Species with a percentage contribution of less than 0.1 are regarded as having a negligable basal area ('neg')

	Juniperus forest			Shume-Magamba	
Species	Plot 1	Plot 2	1 + 2	2100 m	1800 m
Catha edulis	14.1	37.2	25.7	–	–
Diospyros natalensis	19.1	5.5	12.3	–	–
Trichocladus ellipticus	17.3	2.6	10.0	12.9	1.4
Euclea divinorum	–	16.3	8.2	–	–
Warburgia ugandensis	–	13.3	6.7	–	–
Celtis africana	11.3	neg.	5.7	–	–
Cassipourea malosana	10.8	–	5.4	0.9	–
Rawsonia lucida	8.7	1.7	5.2	–	–
Juniperus procera	–	9.7	4.9	–	–
Ehertia cymosa	9.4	–	4.7	–	–
Maytenus sp.	3.2	2.3	2.8	–	–
Ekebergia capensis	1.7	3.6	2.7	–	–
Erythroxylum emarginatum	1.2	2.3	1.8	–	–
Scolopia theifolia	3.1	–	1.6	–	–
Trimeria grandifolia	0.2	–	0.1	–	–
Clerodendrum capitatum	neg.	–	neg.	–	–
Erythrococca fischeri	neg.	–	neg.	–	–
Ochna holstii	neg.	–	neg.	–	–
Psychotria alsophila	neg.	–	neg.	–	–
Solanum usambarense	neg.	neg.	neg.	–	–
Turraea floribunda	neg.		neg.	–	–
Polyscias stuhlmannii	–	–	–	23.2	0.6
Aphloia theiformis	–	–	–	21.1	–
Macaranga kilimandscharica	–	–	–	12.6	–
Maesa lanceolata	–	–	–	8.2	–
Pyschotria cathycalyx	–	–	–	5.0	0.26
Casearia englerii	–	–	–	2.5	–
Ocotea usambarensis	–	–	–	2.0	54.9
Garcinia volkensii	–	–	–	1.6	–
Dracaena afromontana	–	–	–	1.5	–
Syzygium sclerophyllum	–	–	–	1.5	–
Memecylon deminutum	–	–	–	1.1	–

Table 4. Continued

Species	*Juniperus* forest			Shume-Magamba	
	Plot 1	Plot 2	1 + 2	2100 m	1800 m
Lasianthus kilimandscharicus ssp. *laxinervis*	–	–	–	0.9	–
Rapanea melanophloeos	–	–	–	0.7	–
L. kilimandscharicus ssp. *kilimandscharicus*	–	–	–	0.7	2.3
Maytenus acuminata	–	–	–	0.33	–
Xymalos monospora	–	–	–	0.2	–
Peddiea fischeri	–	–	–	0.2	–
Rytigynia uhligii	–	–	–	0.1	–
Chrysophyllum gorungosanum	–	–	–	–	12.2
Craibia brevicaudata	–	–	–	–	6.8
Strombosia scheffleri	–	–	–	–	5.6
Podocarpus	–	–	–	–	4.9
Unknown	–	–	–	–	2.9
Drypetes gerrardii	–	–	–	–	1.9
Dasylepis integra	–	–	–	–	1.6
Eugenia capensis	–	–	–	–	1.0
Pauridiantha paucinervis	–	–	–	–	0.6
Albizia gummifera	–	–	–	–	0.1
Ilex mitis	–	–	–	–	0.1
Asteraceae sp.	–	–	–	–	neg.
Psychotria sp.	–	–	–	–	neg.
Tabernaemontana pachysiphon	–	–	–	–	neg.
Vepris stolzii	–	–	–	–	neg.
% BA in area assessed	0.31	0.47		0.41	1.19

of several normally common forest species, and the presence of several other species not usually associated with such habitats. The Usambara *Juniperus* forests are clearly unsuitable as a habitat for certain forest birds, their places being taken by some unexpected species. The distinct nature of the *Juniperus* forest suggests that it should be classified separately from other Usambara forest types, as was done by Pitt-Schenkel (1938) and Moreau (1935). Under the more recent system of vegetation classification devised for Africa as a whole (White 1983a), the forest is difficult to place. It lacks the species regarded as being characteristic of undifferentiated Afromontane forest, but is not sufficiently dominated by *Juniperus* to be regarded as single-dominant Afromontane *Juniperus procera* forest. A third possibility, dry transitional montane forest, contains some of the species found in the *Juniperus* forest.

Table 5. Avifauna of the two Shume-Magamba sites and the *Juniperus* forest (• indicates presence, – absence). Species common in the *Juniperus* forest are indicated in bold

Species	Shume-Magamba		*Juniperus*
	1800 m	2135 m	
Accipiter tachiro	•	–	•
Buteo oreophilus	•	•	•
Hieraaetus ayresii	•	•	–
Stephanoaetus coronatus	•	•	–
Francolinus squamatus	–	–	•
Aplopelia larvata	•	•	–
Columbia arquatrix	•	•	–
Columba delegorguei	•	•	–
Turtur tympanistria	•	•	–
Tauraco hartlaubi	•	•	•
Cercococcyx montanus	•	–	–
Chrysococcyx cupreus	•	•	–
Chrysococcyx klaas	•	–	–
Ciccaba woodfordii	•	•	–
Apaloderma vittatum	•	•	–
Phoeniculus purpureus	•	•	–
Merops oreobates	•	•	•
Tockus alboterminatus	•	•	•
Buccanodon olivaceum	•	–	–
Pogoniulus leucomystax	•	•	•
Indicator variegatus	•	–	–
Dendropicus griseocephalus	•	•	•
Dicrurus adsimilis	–	–	•
Pseudoalcippe abyssinica	•	•	•
Coracina caesia	•	–	–
Andropadus masukuensis	•	•	•
Andropadus milanjensis	•	•	•
Andropadus nigriceps	•	•	•
Phyllastrephus debilis	•	•	–
Phyllastrephus cabanisi	•	•	•
Alethe fuelleborni	•	•	•
Cossypha caffra	–	–	•
Sheppardia montana	•	•	–
Modulatrix stictigula	•	•	•
Pogonocichla stellata	•	•	•

Table 5. Continued

Species	Shume-Magamba 1800 m	Shume-Magamba 2135 m	*Juniperus*
Turdus olivaceus	•	•	•
Zoothera gurneyi	•	–	–
Apalis melanocephala	•	•	•
Apalis thoracica	•	•	•
Bradypterus lopezi	•	•	•
Bradypterus cinnamomeus	–	–	•
Orthotomus metopias	•	•	•
Phylloscopus ruficapilla	•	•	•
Muscicapa adusta	•	•	•
Batis capensis	•	•	•
Terpsiphone viridis	•	•	–
Trochocercus albonotatus	•	•	•
Dryoscopus cubla	•	•	•
Laniarius fuelleborni	•	•	•
Malaconotus nigrifrons	•	•	•
Prionops retzii	–	–	•
Cinnyricinclus sharpii	•	–	–
Onychognathus walleri	•	•	–
Poeoptera kenricki	•	–	–
Nectarinia mediocris	•	•	•
Nectarinia olivacea	•	•	–
Zosterops senegalensis	•	•	•
Ploceus nicolli	•	•	–
Cryptospiza reichenovii	•	•	•
Linurgus olivaceus	•	•	–
Totals	55	46	35

The unique nature of the forest is further underlined by the occurrence of some unusual and interesting tree species. *Calodendrum eickii* is only known from this locality and is one of two species of *Calodendrum*, the other being *C. capense* which is widespread in upland dry evergreen forests throughout eastern and southern Africa, and from which it differs by having much larger fruits with longer spines and smaller flowers (Kokwaro 1982). The monotypic *Platypterocarpus tanganyikensis* is reported as occurring in the Shume *Juniperus / Podocarpus / Ficalhoa* forest, but was not found during the field work. *Ptaeroxylon obliquum*, a monotypic genus with a scattered distribution through southern Africa, is at its northern limit of distribution

here (White & Styles 1966). The only other genus in the Ptaeroxylaceae is *Cedrelopsis* from Madagascar (Pennington & Styles 1975). The *Diospyros natalensis* found at Shume is a distinct small-leaved variant with ascending branches, but is currently not regarded as being sufficiently distinct for formal taxonomic rank (White 1983b, 1988). No particularly rare or unusual bird species were found in the forests, but as a community, it is a unique assemblage. For this reason alone the small remaining area is worthy of careful conservation and management measures to assure its long-term survival.

The *Juniperus* forest is utilised by local people for a variety of products. *Juniperus procera* provides bark for roofing, and the split wood is used for fence construction. *Catha edulis* leaves are plucked for *khat*, a stimulant (Verdcourt & Trump 1969) which is gathered and sold outside the area. It is also a prefered firewood and the tree coppices readily. *Warburgia ugandensis* bark is regarded as a powerful medicine for chest complaints. *Olea europea* ssp. *africana* leaves are used to clean *pombe* (local beer) pots and to flavour the *pombe* itself. *Euclea divinorum* roots are used to help back ache, and the underbark is used to colour teeth yellow. *Trimeria grandifolia* roots are mixed with those of *Croton dictyophlebodes* and used against fatigue. Cattle and goats are also grazed in the forest, as grazing in the surrounding area has deteriorated due to soil erosion.

The *Juniperus* forest is also of potential economic importance as a provenance of timber species. The forests of the ancient crystalline mountains of south-east Kenya and eastern Tanzania (Eastern Arc mountains, Lovett 1988) have been isolated from other forest areas for a considerable period of time. Consequently species occurring in them may represent unique genotypes. Three tree species of the *Juniperus* forest are valued as timber. *Juniperus procera* was formerly used extensively for the production of pencils and window slats. *Ptaeroxylon obliquum* is a valued timber in southern Africa, and *Warburgia ugandensis* is also used (Coates-Palgrave 1977, Dale & Greenway 1961).

The *Juniperus* forest is thus of conservation importance for a number of reasons. It is the last remnant of a more widespread forest type in the West Usambaras which is markedly different from the other forest types. It contains a number of species of restricted or interesting distribution. It is heavily utilized by the local people as a source of forest products, and it represents a genetic resource for a number of species of economic interest.

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Weights and fat scores of migrating and wintering Blackcaps *Sylvia atricapilla* in the Sudan

Gerhard Nikolaus

Visible fat score has often been discussed as an index of flight range in migrating birds (e.g. Biebach *et al.* 1989, Greenwood 1992). Fat score reflects total body fat content closely within a species, but interspecific comparison may be limited by small differences of body proportion and fat distribution pattern. Fat scores are generally linked to body weight, but weight may be affected significantly by components other than fat. Thus protein may provide an additional energy source on migration (e.g. Lindstrom & Piersma 1993), influencing both weight and flight range. Water is a third component of importance, especially for birds facing a long sea or desert crossing (Moreau & Dolp 1970): changes in water content can markedly affect the weight of a migrant irrespective of its fat status.

This paper presents a comparison of the weights and fat scores of Blackcaps *Sylvia atricapilla* from two sites in Sudan, one used on autumn passage and the other as a wintering area. A striking weight difference between the two sites was due to body components other than fat.

Study sites and methods

Blackcaps were caught and ringed in northeast Sudan on the Red Sea Coast (approx. 19° N, 37° E) during September-November between 1980 and 1982, and in south Sudan in the Imatong Mts (4° N, 33° E) during December and January between 1978 and 1981.

The Red Sea Coast

The Red Sea Hills offer a fairly dry rocky habitat on the southern edge of the desert belt, with open bush vegetation. The area is arid in autumn with little water available, for the annual rains fall here between November and January. The main food sources for migrating passerines are probably associated with acacias along the wadis. On the coastal plains conditions are still hotter, with daily temperatures often well above 40°C, and bush and ground cover sparse and leafless. The few mangrove patches provide a temporary refuge for migrants grounded along the shore.

Blackcaps occur on the Red Sea coast almost entirely as passage migrants. Autumn migration begins in mid September, peaks in the second half of

October, then tails off until late November. Birds arrive after crossing 1000–2000 km of desert and open sea. Some stay for a few days to use the limited feeding possibilities.

The Imatong Mountains

These highlands near the Uganda border rise to about 3000 m. They offer ideal feeding and wintering conditions for Blackcaps, especially in the open secondary growth of degraded forest above 1600 m. The first birds arrive in late November, and the main wintering numbers are present from mid December until March.

Blackcaps were caught at both sites with mist-nets and immediately processed. Wing-length (maximum flattened chord) was recorded by the author according to Spencer (1984, method (iii)). Birds were weighed to the nearest 0.5 g using a 'Pesola' spring balance of range 0–50 g. Fat was scored according to Pearson & Backhurst (1976), using a 1–4 scale based on the appearance of the tracheal pit, as follows:

1 Fat absent or in traces only (pit 10% covered)
2 Pit partly covered with fat
3 Pit fully covered and level with pectoral muscles
4 Pit covered, bulging and overflowing above the pectoral muscles.

In practice, birds with a fat score of 4 were not encountered.

Plumage colour and wing-lengths indicated that Blackcaps from both sites were nominate-race birds from the eastern part of the breeding range, probably from Scandinavia and European Russia.

Results and discussion

Table 1 shows weights for three different periods on the Red Sea coast, and for two different periods in the Imatongs. In each case details are presented for the whole sample and separately for birds with fat scores of 1, 2 and 3 respectively.

On the Red Sea coast, weights ranged from 13–21 g, but about half of all birds still had moderate fat reserves (Fat 2–3). Mean weight decreased during the passage season, from almost 17 g in early October to below 16 g in November. There was a corresponding decrease in the percentage of birds scoring Fat 3 (from 43% in early Oct to 9% in Nov). In the Imatongs, weights were much higher than at the Red Sea, ranging from 17– 23 g, with a mean of 19.9 g in December and 19.3 g in January. Yet visible fat scores were if anything lower than at the Red Sea, with few birds scoring 3. Table 2 compares weights of Red Sea and Imatongs birds with the same fat score. A difference of about 4 g emerges for all three categories.

Red Sea weights were very low. The overall mean of 16.2 g was far below that of lean birds on breeding grounds in southern Finland (19.2 g; Berthold

Table 1. Weights of Blackcaps caught during various autumn and winter periods at the Red Sea Coast and the Imatong Mts, Sudan

	N	Weights (g)		
		Mean	S.d.	Range
Red Sea, Sep/first half Oct				
Whole sample	23	16.9	1.66	13.0–19.5
Fat 1	5	15.3	1.60	13.0–17.5
Fat 2	8	16.7	0.97	15.5–18.5
Fat 3	10	17.7	1.29	16.0–19.5
Red Sea, second half Oct				
Whole sample	125	16.2	1.41	13.5–21.0
Fat 1	64	15.6	0.92	13.5–18.0
Fat 2	41	16.2	1.12	13.5–18.0
Fat 3	20	18.1	1.36	16.0–21.0
Red Sea, Nov				
Whole sample	32	15.8	1.51	13.0–19.0
Fat 1	20	14.9	0.91	13.0–16.0
Fat 2	9	17.7	0.75	16.0–18.0
Fat 3	3	17.2	1.02	16.5–19.0
Imatongs, Dec				
Whole sample	154	19.9	1.26	17.0–22.5
Fat 1	78	19.2	1.05	17.0–21.5
Fat 2	72	20.6	1.00	18.5–22.5
Fat 3	4	21.6	0.89	20.5–22.5
Imatongs, Jan				
Whole sample	98	19.3	1.14	17.0–23.0
Fat 1	71	19.0	1.01	17.0–21.5
Fat 2	26	20.1	0.89	18.5–22.0
Fat 3	1	23.0	—	23.0

Table 2. Weights of Blackcaps with particular fat scores: Red Sea and Imatong birds compared

	N	Weights (g)	
		Mean	Range
Fat 1			
Red Sea	89	15.38	13.0–18.0
Imatongs	149	19.11	17.0–21.5
Fat 2			
Red Sea	58	16.40	13.5–18.0
Imatongs	98	20.44	18.5–22.5
Fat 3			
Red Sea	33	17.91	16.0–21.0
Imatongs	5	21.90	20.5–23.0

et al. 1990). Yet moderately fat birds (Fat 2–3) were well represented among passage arrivals, especially early in the migration period. Birds trapped on the wintering grounds 2000 km further south some 4-6 weeks later had regained good body weights, similar to those of the Finnish breeding birds, but the majority, especially in January, were lean (Fat 1).

Visible fat score should reflect the stored fat level. The difference in weight at the two study areas between birds with the same fat score must indicate a major difference in body components other than fat. Three factors are likely to have been involved. The Red Sea birds probably carried less protein (and associated water) than those in the Imatongs. After an arduous desert crossing they may well also have been dehydrated, in the sense of having a low water index (water to non-fat body weight ratio). Finally, the stomachs of these migratory transients may have held less food.

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Additions to the known avifauna of the Rwenzori Mountains National Park in western Uganda

Morton Dehn and Lars Christiansen

The Rwenzori Mountains National Park (RMNP, 0°06′–0°46′ N, 29°47′–30°11′ E; Fig. 1) in western Uganda was created in 1991, and made a World Heritage Site in 1994. There have been a number of bird surveys in the Rwenzoris, although coverage has been patchy (Ogilvie-Grant 1910, Van Someren & Van Someren 1949, Weekes 1949a, 1949b, Buckley *et al.* 1989, Howard 1991, Francis & Penford 1991, Howard *et al.* 1996, Roy *et al.* 1997, Willard *et al.* 1998, Dehn & Christiansen 1998). Two recent publications list the bird species recorded there (Wilson 1995, Howard *et al.* 1996). The RMNP has fewer species of birds than other forests in western Uganda (Butynski & Kalina 1993, Wilson 1995, Howard *et al.* 1996). In part this might be because surveys are incomplete, or because of the almost complete deforestation of the lower slopes (below 2000 m in Bundibugyo District and below 1800 m in Kasese District). This effectively isolates the montane forest from the surrounding, species-rich lowland forest.

From July to August 1996, assisted by Eric Sande from Makerere University, we conducted four single-day surveys (at Harugali, Ngiti, Kagugu and Kakuka), and one twelve-day survey (at Kakuka) in Bundibugyo District. From August to December 1996, we worked for a total of 111 days along the Mubuku River system (Kasese District). Using visual and vocal observation and mist-netting, we recorded 139 species of birds in RMNP. The mist-net effort was 28,200 net metre-hours, and 911 individuals of 60 species were captured. At least one member of all species mist-netted was photographed and a blood-sample taken for DNA analysis.

Below, we give details of 17 species for which we find no previous published records in the RMNP (Ogilvie-Grant 1910, Buckley *et al.* 1989, Francis & Penford 1991, Wilson 1995, Howard *et al.* 1996, Willard *et al.* 1998).

Additions to the Rwenzori Mountains National Park bird list

The species number, sequence and nomenclature follow Ornithological Subcommittee (1996). All dates refer to the year 1996.

55 ***Ciconia abdimii* Abdim's Stork** Four birds were seen gliding (eastwards) high over the montane forest by the Nyabitaba Hut, Mubuku Valley, 2650 m, 11 November.

117 ***Polyboroides typus*** **African Harrier-Hawk** Seen frequently (> 10 times) in the Mubuku Valley, 1800 m to 2400 m, between September and October. One bird was seen at 2100 m carrying twigs and branches, presumably for nest-building.

133 ***Accipiter rufiventris*** **Rufous-breasted Sparrowhawk** An individual distinguishable by the damaged primaries on its left wing was observed on several occasions at 2700 m in the Mubuku Valley from 5–9 November. The bird was seen hunting low over the forest canopy, and was also observed perched in the top of a tree in the *Podocarpus-Arundinaria* transitional zone. Two birds of this species were observed calling at 2720 m on 5 November.

144 ***Gypohierax angolensis*** **Palm-nut Vulture** One immature bird was seen flying into the Mubuku Valley at 1800 m on 15 September.

158 ***Polemaetus bellicosus*** **Martial Eagle** One adult bird was seen in the Mubuku Valley at 2400 m on 20 October. The bird was soaring the slopes for thermals and glided off in a south-eastern direction towards the town of Hima.

442 ***Glaucidium tephronotum*** **Red-chested Owlet** One adult bird was mist-netted in *Symphonia globulifera* forest in the Mubuku Valley at 2100 m on 28 September. This sub-species, *medje*, has chestnut-red flanks and a white chest with black streaks, and is only found in the Albertine Rift Mountains.

477 ***Apus caffer*** **White-rumped Swift** Observed flying over our camp at Kakuka at 1970 m on 5 August.

668 ***Hirundo fuligula*** **Rock Martin** Seen at the edge of the montane forest at Kakuka at 1970 m on 27 July (ten), 3 August (two) and 5 August (five).

710 ***Phyllastrephus hypochloris*** **Toro Olive Greenbul** Fourteen captured in total, on the Kakuka Ridge, 1930–1975 m, in July and August, and in the Mubuku Valley, 1800–2400 m, in September and October.

761 ***Sheppardia aequatorialis*** **Equatorial Akalat** Two captured on the Kakuka Ridge at 1970 m, on 4 August (one adult) and 7 August (one immature).

766 ***Sheppardia polioptera*** **Grey-winged Robin** One captured in the Mubuku Valley at 1800 m on 10 September. This species was seen and heard daily inside the forest.

924 ***Prinia subflava*** **Tawny-flanked Prinia** Two observed in the secondary scrub at the Kakuka Ridge at 1950 m on 29 July.

936 ***Apalis flavida*** **Yellow-breasted Apalis** One adult captured in degraded secondary forest on the Kakuka Ridge at 2030 m on 5 August. One also observed at the forest edge in the Mubuku Valley at 1800 m on 3 September.

1004 ***Trochocercus cyanomelas*** **Blue-mantled Crested Flycatcher** Two immature birds captured, one in secondary forest on the Kakuka Ridge at

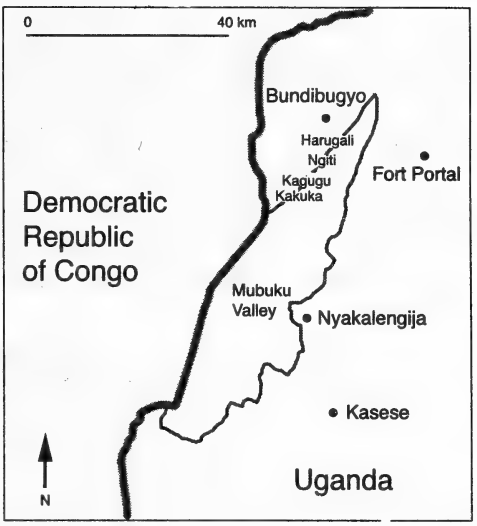

Figure 1. Sketch map showing the park boundary (thin line) and the border (thick line) between Uganda and the Democratic Republic of Congo.

1980 m on 2 August, and one in primary forest in the Mubuku Valley at 1800 m on 12 September.

1076 ***Campephaga flava*** **Black Cuckoo-shrike** Several adults were seen perched and foraging in the canopy of trees at the Mubuku grass-forest ecotone, at 1800 m, between 30 August and 7 September.

1209 ***Ploceus nigricollis*** **Black-necked Weaver** Observed daily in trees at the grass-forest ecotone in the Mubuku Valley at 1800 m between August and September. This record apparently constitutes an upward altitudinal range extension of 300 m (Mackworth-Praed & Grant 1970, Britton 1980).

1349 ***Linurgus olivaceus*** **Oriole Finch** Two male birds observed in the canopy of the forest in the Mubuku Valley at 1800 m on 19 September.

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New records of uncommon and poorly known species for Ugandan National Parks and Forest Reserves

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From March to May 1998, with the joint co-operation of the Uganda Tourist Board, Uganda National Parks the Forestry Department, informal research was conducted in some of the protected areas in Uganda. The aim was to produce 'Where to watch birds in Uganda' (Rossouw & Sacchi 1998), a birder's site guide promoting avitourism in the country's national parks, major forest reserves and other birding areas. Using the national parks checklists produced by the National Biodiversity Data Bank (NBDB) (Wilson 1995) and the recent Forestry Department Biodiversity Reports (FDBR)(Howard & Davenport 1996) as references, we recorded a number of birds new to the various protected areas. Here we detail records of some rare or poorly known species encountered during our survey, supplementing the information in Britton (1980). Many new records for National Park (NP) lists were of common, widespread species previously not listed from remote and little visited sites, such as Mgahinga NP. These records are held by the NBDB but are not reported on here.

The main sites visited were: Mabira Forest Reserve (0°30′ N, 33°00′ E), 9–12 March and 23 May; Lake Mburo NP (0°40′ S, 30°55′ E), 18–19 March; Bwindi Impenetrable NP (1°00′ S, 29°40′ E), 20–26 March and 29 March–5 April; Mgahinga NP (1°20′ S, 29°40′ E), 27–28 March; Echuya Forest Reserve (1°10′ S, 29°50′ E), 29 March; Queen Elizabeth NP (0°10′ S, 29°50′ E), 5–13 April; Semliki NP (0°52′ N, 30°05′ E), 14–22 April and 26–31 May; Semliki Wildlife Reserve (WR) (1°00′ N, 30°15′ E), 22–25 April; Kibale NP (0°30′ N, 30°25′ E), 26–30 April; Budongo Forest Reserve (1°45′ N, 31°35′ E), 1–3 May and 11–13 May; Murchison Falls NP (2°20′ N, 31°45′ E), 4–10 May; Kidepo Valley NP (3°50′ N, 33°45′ E), 16–21 May; Mt Elgon NP (0°10′ N, 34°30′ E), 23–25 May; and Mt Moroto area (2°30′ N, 34°45′ E), 25–26 May.

The following observers participated in various stages of the field work: Michael Green (MG) 9 March–23 April; Jeremy Lindsell (JL) 1–21 May and 26–31 May; Adam Riley (AR) 11–31 May, Jonathan Rossouw (JR) and Sherran Rossouw (SR) 9 March–31 May, Marco Sacchi (MS) 9 March–21 May; Malcolm Wilson (MW) 5–25 April and 26–31 May, and Katie Wilson (KW) 26–31 May. Observations were made by all observers unless otherwise indicated.

Dwarf Bittern ***Ixobrychus sturmii*** Three adults in the Ishasha sector of Queen Elizabeth NP on 5 April and a single adult at an oxbow lake along the Narus River in Kidepo Valley NP on 17 May. The latter is the first park record of this species, considered a "widespread but uncommon visitor" by Britton (1980).

Rufous-bellied Heron ***Ardeola rufiventris*** An adult on the northern edge of Lake Opeta (1°39′ N, 34°10′ E) on 26 May (AR, JR and SR). Britton (1980) considered the species "widespread but local", with an "apparent absence" from the papyrus swamps of E Uganda.

Spot-breasted Ibis ***Bostrychia rara*** A single vocalising individual landed at the edge of an oxbow of the Kirumia River, Semliki NP on the evening of the 29 May and subsequently flushed, issuing further vocalisations. A second individual, possibly the same bird, called from the same area at dawn on 30 May. Its call was tape-recorded by JR. Similar vocalisations were heard and tape-recorded on the evening of 30 May (single individuals) and at dawn on 31 May (at least two birds). The specific identity of the birds could not be established at the time, but subsequent review of the literature and analysis of our tape recordings confirmed their identity as *B. rara*. The distinctive soft vocalisation with the accent on the second syllable is considered to be the best means of identifying this elusive species, a recent addition to the East African avifauna (Ash *et al.* 1991a).

African Cuckoo Hawk ***Aviceda cuculoides*** Singles, probably the same bird, along the 'Kirumia Trail', Semliki NP on 17 and 19 April (JR, SR and MW) were engaged in characteristic, steeply undulating display flight. Absent from the NBDB park list, though apparently previously recorded in Semliki (D. Pomeroy pers. comm.).

Eurasian Honey Buzzard ***Pernis apivorus*** Single dark-phase adult *c.* 20 km west of Kampala on 15 March (JR, SR and MS) and a single barred-phase adult at Murchison Falls on 8 and 9 May (JL, JR and SR), the latter confirming the previous records from Murchison Falls NP. "Generally uncommon and seldom recorded" in Uganda (Pearson &Turner 1986), most East African records coming from "east of the Kenya-Tanzania rift" (Britton 1980).

Egyptian Vulture ***Neophron percnopterus*** Single sub-adult near Lake Kikorongo, Queen Elizabeth NP on 9 April. "Occasional" away from drier areas in E Uganda (Britton 1980).

'Beaudouin's' Short-toed Snake Eagle ***Circaetus gallicus beaudouini*** An adult perched near Mweya, Queen Elizabeth NP on 9 April, subsequently seen soaring and in hovering flight (MG, JR, MS, MW), and an adult in flight near Masindi on 11 May (JL, JR, SR, MS). An individual suspected to be this species (and possibly the same Mweya bird) was seen in the area in late March by MW. This scarce species is not present on the NBDB list for Queen Elizabeth NP although Britton (1980) reports "occasional birds at Rwenzori

National Park [the name for Queen Elizabeth NP at that time]... in W Uganda".

Red-thighed Sparrowhawk ***Accipiter erythropus*** An adult seen on 19 April in Semliki NP, its only East African locality, was observed being mobbed by a party of small passerines (JR). Although the species is inconspicuous, it "might be reasonably common" (Britton 1980).

Steppe Eagle ***Aquila nipalensis*** An adult near Ishasha and an adult and an immature *c.* 30 km SW of Katunguru, Queen Elizabeth NP on 6 April flew steadily northwards and may have been passage migrants. Though considered scarce by Pearson & Turner (1986), with "all records from the north and north-east", the species is present on the NBDB list for Queen Elizabeth NP.

Ayres's Hawk-Eagle ***Hieraaetus ayresii*** One seen daily (14–16 April) near Sempaya, Semliki NP and one in Narus Valley, Kidepo Valley NP on 17 May. Considered "scarce and local" by Britton (1980).

Sooty Falcon ***Falco concolor*** An adult flying steadily northwards on 4 April with Common Buzzards *Buteo buteo* over Buhoma, Bwindi Impenetrable NP, presumably on passage, is a new record for the park. Considered an uncommon passage migrant by Pearson & Turner (1986), with records of small parties in Murchison Falls NP and near Masindi suggesting a migration route along the Albertine Rift.

Common Quail ***Coturnix coturnix*** Though greatly outnumbered by Harlequin Quail *Coturnix delegorguei*, at least four (probably more) were present in moist grassland in the Narus Valley on 17 May, constituting the first record of this species in Kidepo Valley NP. The race involved could not be determined.

Buff-spotted Flufftail *Sarothrura elegans*. The distinctive hooting vocalisation of a male of this species was heard issuing from dense *Acacia* thicket at Paraa, Murchison Falls NP from 23:10 on 6 May to *c.* 03:00 on 7 May (JR, SR). This is the first record of *S. elegans* in Murchison Falls NP, though the species is fairly common in the adjacent Budongo Forest Reserve (pers. obs.). Three males were heard calling from the undergrowth of montane forest in Mount Elgon NP on 24 May (AR, JR, SR); though absent from the NBDB list, the species is reported in the FDBR for the park.

Red-chested Flufftail ***Sarothrura rufa*** Two heard delivering the repeated *dueh* territorial call on 22 March from Mubwindi Swamp in Bwindi Impenetrable NP, a site where this species has previously been recorded (Ash *et al.* 1991b). A similar vocalisation, as well as a short bout of the hooting song of the male, was tape-recorded at the edge of a small marsh in Kibale NP on 29 April (JR, MS). This constitutes the first park record of *S. rufa*, a species known in Uganda from only three records prior to 1980 (Britton 1980).

Nkulengu Rail ***Himantornis haematopus*** Characteristic duets of this elusive species were heard in Semliki NP near Sempaya Hot Springs (28 May) and at two sites on the 'Kirumia Trail' (17, 18 April and 29–31 May), usually an hour after sunset. A pair that vocalised from a perch 5 m above the trail at 20:10 on 30 May, called from the same position at *c.* 05:00 on 31 May and were subsequently seen in flight and running along thick branches up to 15 m off the ground. Semliki NP is the only Ugandan locality for this forest rail, until 1980 known only from a single record (Britton 1980).

Spotted Crake ***Porzana porzana*** An adult bird in moist grassland with muddy pools near Ishasha, Queen Elizabeth NP on 6 April is a new park record; a second was in similar habitat on the Semliki Flats (1°00′ N, 30°30′ E) on 25 April. There are three previous records from Uganda (Pearson & Turner 1986), none from within national parks.

Purple Swamphen ***Porphyrio porphyrio*** Though absent from the NBDB list for Murchison Falls NP, no fewer than eight individuals were seen on the launch cruise from Paraa to Murchison Falls on 8 May, including an adult with three downy young. Britton (1980) considered this species common in the papyrus swamps of the Lake Victoria basin but "hardly known elsewhere in Uganda". It seems inconceivable that so conspicuous a species could remain undetected in such a frequently visited site; these sightings probably reflect a recent range extension of the species down the Victoria Nile.

Rock Pratincole ***Glareola nuchalis*** One sub-adult perched on a road in Queen Elizabeth NP at *c.* 22:00 on 9 April was possibly involved in post-breeding dispersal. The species' closest breeding sites are on rocks in the Semliki and Nile Rivers and "there are no records away from these breeding sites" (Britton 1980), though the NBDB lists it for Queen Elizabeth NP.

Western Bronze-naped Pigeon ***Columba iriditorques*** Three crossing ridges near Ruhizha (2300 m) between 20–26 March, four near Kitahurira (1550 m) on 21 March and small numbers daily near Buhoma (1550 m), Bwindi Impenetrable NP from 31 March–4 April. Small numbers daily along 'Kirumia Trail', Semliki NP from 17–19 April; fewer present (less vocal?) from 29–31 May. The two records reported in Britton (1980) are from these two reserves. A small *Columba* in flight over the forest in Kibale NP on 30 April (JR, SR) was also thought to be this species; however, *C. delegorguei* could not be excluded.

Vinaceous Dove ***Streptopelia vinacea*** Large numbers daily in both Murchison Falls NP and Kidepo Valley NP, with only single Ring-necked Doves *S. capicola* recorded in each reserve (relative abundance *contra* NBDB list).

Black-collared Lovebird ***Agapornis swinderniana*** A pair on 2 May in Budongo FR (JL, JR, SR), where apparently rare (JL pers. comm.). Known elsewhere in Uganda from Semliki NP and an old record in Maramagambo Forest (Britton 1980).

Olive Long-tailed Cuckoo *Cercococcyx olivinus* Small numbers at medium altitudes (*c.* 1550 m) in Bwindi Impenetrable NP from mid-March to early April, daily in Kibale NP from 28–30 April and once in Budongo FR on 11 May. Barred Long-tailed Cuckoo *C. montanus* was very common at high altitudes in Bwindi Impenetrable NP, while Dusky Long-tailed Cuckoo *C. mechowi* was uncommon to common in Mabira FR, Bwindi Impenetrable NP, Kibale NP, Semliki NP and Budongo FR. At Buhoma in Bwindi Impenetrable NP, where *C. olivinus* and *C. mechowi* are sympatric, *olivinus* favoured more broken forest and forest edge and seemed absent from taller forest with a closed canopy. Its apparently more common congener was recorded in both forest types. Both species called mainly at dawn and dusk or after rain and were responsive to tape playback.

Black-throated Coucal *Centropus leucogaster* Two seen and at least four others heard and tape-recorded along the 'Kirumia Trail', Semliki NP from 28–31 May are the first records of this forest coucal in East Africa (Rossouw & Lindsell 2001).

Fraser's Eagle-Owl *Bubo poensis* A single bird heard calling below Ruhizha, Bwindi Impenetrable NP on 24 March (JR, SR). A rarely recorded forest owl known in Uganda from two specimens (Britton 1980) and recent sight records (A. Twinomujuni, pers. comm.) in Bwindi Impenetrable NP.

Pel's Fishing Owl *Scotopelia peli* An adult roosting in dense, waterside *Acacia* along the Victoria Nile above Paraa on 8 May and a second flushed from riverine forest below the falls, Murchison Falls NP on 9 May. Formerly known in Uganda from only a handful of records in Murchison Falls NP, this species has recently been recorded in Semliki NP (Ash *et al.* 1991b).

Red-chested Owlet *Glaucidium tephronotum* One seen and heard in Mount Elgon NP on 25 May (SR). An uncommon, localised resident (Britton 1980).

[African Barred Owlet *Glaucidium capense* On 23 April in Semliki WR, a Spotted Morning Thrush *Cichladusa guttata* was heard mimicking a call virtually identical to that of *G. c. ngamiense*, the sub-species with which the observers are most familiar. The only record of this owlet in Uganda is a specimen of the forest-dwelling race *G. c. castaneum*, taken in Semliki NP on 8 December 1968 (Friedmann & Williams 1971). *G. c. castaneum* is sometimes considered a distinct species, the Chestnut Owlet, and is a "rare and little known" resident of forest in the Semliki Valley (Britton 1980, Fry *et al.* 1988). Despite extensive searches at dawn, dusk and at night (23–25 April), including the use of tape playback of *G. c. ngamiense*, the owlet itself was not seen or heard.]

African White-tailed Nightjar *Caprimulgus natalensis* Fairly common in Kidepo Valley NP from 16–20 May, with over ten seen and heard daily in the moist Narus Valley.

Dusky Nightjar ***Caprimulgus fraenatus*** A single male of this species, recently recorded for the first time in Uganda (Ash 1985), was heard and seen 3 km south-east of Moroto town on 25 May.

Slender-tailed Nightjar ***Caprimulgus clarus*** At least six heard, seen and photographed approximately 8 km north of Apoka in Kidepo Valley NP on 19 and 20 May.

African Black Swift ***Apus barbatus*** A small flock in Mount Elgon NP on 24 May confirms the previous record(s) for this national park. This species is also known from the Kenyan side of Mount Elgon (Zimmerman *et al.* 1996).

Chocolate-backed Kingfisher ***Halcyon badia*** A pair in Maramagambo Forest, Queen Elizabeth NP on 11 March, small numbers daily on the 'Kirumia Trail', Semliki NP (17–19 April and 29–31 May) and common along the 'Royal Mile', Budongo FR on 2 and 12 May. A 'local and generally uncommon resident', known elsewhere in Uganda only from Bugoma FR (Britton 1980).

Shining-blue Kingfisher ***Alcedo quadribrachys*** One in Entebbe Botanical Gardens on 13 March, two in Semliki NP on 17 April and 30 May and one, probably the same individual, seen daily near Busingiro, Budongo FR (1–5 and 12–13 May). An uncommon resident of lowland forest (Britton 1980).

Black Scimitarbill ***Rhinopomastus aterrimus*** Two near Busingiro on 13 May.

White-crested Hornbill ***Tropicranus albocristatus*** One seen daily (14–17 April) in the Sempaya area, Semliki NP, was observed carrying food on numerous occasions, and at least three individuals were present along the 'Kirumia Trail' from 29–31 May. Considered "rare or extra-limital...with no recent records" by Britton (1980), though recorded by Ash *et al.* (1991b).

Moustached Green Tinkerbird ***Pogoniulus leucomystax*** Two birds in Mount Elgon NP on 24 May. This species has only been recorded twice previously in Uganda (van Someren 1918, Dranzoa & Rodrigues 1990) but is fairly common in forest on the Kenyan side of Mount Elgon (Zimmerman *et al.* 1996).

Yellow-spotted Barbet ***Buccanodon duchaillui*** Two in Mount Elgon NP on 24 May constitute the first park records, though the species is known from the Kenyan side of the mountain (Zimmerman *et al.* 1996).

Scaly-throated Honeyguide ***Indicator variegatus*** One heard and seen at Magombe Swamp on 27 April, though the species is unrecorded within the adjacent Kibale NP.

Dwarf Honeyguide ***Indicator pumilio*** Three individuals in Bwindi Impenetrable NP, 20–26 March. A "rare and little-known species", known in East Africa only from Bwindi Impenetrable NP (Britton 1980).

Zenker's Honeyguide ***Melignomon zenkeri*** One along the 'Kirumia Trail' in

Semliki NP on 29 May. This observation will be discussed in detail elsewhere (JL in prep.). Prior to this sight record, known in East Africa on the basis of a single specimen collected in Semliki in 1967 (Friedmann & Williams 1971).

Gabon Woodpecker ***Dendropicos gabonensis*** Two on 17 April and two on 30 May in Semliki NP. Previously known in Uganda from two specimens collected in Semliki in 1967 (Britton 1980).

Elliot's Woodpecker ***Dendropicus elliotii*** At least two pairs near Buhoma, Bwindi Impenetrable NP (30 March–5 April), always seen foraging with mixed-species flocks. A pair and a single along the 'Kirumia Trail', Semliki NP on 18 April. Described as an apparently rare resident by Britton (1980).

African Green Broadbill ***Pseudocalyptomena graueri*** One near Mubwindi Swamp, Bwindi Impenetrable NP on 22 March and again on the 24 March, perched in the canopy and reacting aggressively towards nearby birds, including Montane Oriole *Oriolus percivali.* A pair was seen feeding recently fledged young in the same area a few days later (JL). Bwindi Impenetrable NP is the only East African site for this "apparently rare resident" (Britton 1980).

Cliff Swallow species ***Hirundo*** **sp.** An individual of an unidentified species of cliff swallow was seen in a mixed flock of swallows and swifts in Kidepo Valley NP on 17 May (JR, JL). The bird closely resembled South African Cliff Swallow *H. spilodera* except for its uniformly blue-black upperparts and pale buff underparts with indistinct breast streaking, and may be similar to cliff swallows seen recently in Ethiopia (Madge and Redman, in Keith *et al.* 1992).

Common House Martin ***Delichon urbica*** Numerous small flocks moving northwards along the edge of the Albertine Rift Valley near Budongo FR on 4 May were presumably passage migrants. In Uganda, considered scarce away from the eastern highlands (Pearson & Turner 1986).

Leaflove ***Pyrrhurus scandens*** A group of three birds in Mabira FR on 10 March (MG) and again on the 11 March (all observers), and very common (*c.* 1 group per 3 ha of gallery forest) in Semliki Wildlife Reserve. Considered scarce and local in Uganda, except in the "Bwamba (Semliki) lowlands", where common (Britton 1980).

Joyful Greenbul ***Chlorocichla laetissima*** One in Mabira FR on 10 March confirms previous sight records from this forest. At least three (possibly the same individuals) seen daily in *Cyanometra*-dominant forest in Semliki NP (17–19 April) and fairly common in Kibale NP (27–31 April). Considered scarce and local in Uganda, except in Kibale NP, where "common" (Britton 1980).

Simple Greenbul ***Chlorocichla simplex*** One seen on 17 April in Semliki NP, its only known East African locality. Previously known in Uganda from four old specimens (Friedmann & Williams 1971).

Puvel's Illadopsis ***Illadopsis puveli*** Common (> 10 on 11 May) in the Kaniyo-Pabidi sector of Budongo FR. This species is a recent addition to the East African avifauna (Plumptre & Owiunji 1997).

Kivu Ground Thrush ***Zoothera tanganjicae*** At least five individuals seen, heard and tape-recorded (JR) in Bwindi Impenetrable NP (30 March–5 April). They were observed foraging silently on forest tracks at first light and vocalising for long periods from perches in the lower canopy, mainly in the mid-morning (09:00–11:00).

Uganda Woodland Warbler ***Phylloscopus budongoensis*** One in a mixed-species flock in Kibale NP on 29 April constitutes the first park record of this species, which is "sparsely distributed" through medium altitude forests in Uganda (Britton 1980).

Broad-tailed Warbler ***Schoenicola brevirostris*** Common (> 10 daily) in seasonally moist grassland in the Narus Valley, Kidepo Valley NP (16–21 May). This confirms the previous park record(s).

Papyrus Yellow Warbler ***Chloropeta gracilirostris*** One in papyrus at the edge of Lake Mburo, Lake Mburo NP on 19 March. A scarce and localised species of papyrus swamps (Britton 1980).

Dark-capped Yellow Warbler ***Chloropeta natalensis*** Two near Maramagambo Forest, Queen Elizabeth NP on 11 April (JR, MW) and one near Busingiro, Budongo FR on 13 May (JR) constitute the first records for these reserves of this "wide-ranging but generally rather uncommon bird" (Britton 1980).

Karamoja Apalis ***Apalis karamojae*** One in sparse Whistling Thorn *Acacia drepanolobium* in the arid Kidepo Valley, Kidepo Valley NP on 20 May (JL, AR, JR, SR) is only the sixth Ugandan record of this highly localised and globally threatened species (Collar & Stuart 1988).

Black-collared Apalis ***Apalis pulchra*** A recent addition to the Uganda list (Dranzoa & Rodrigues 1990), this species was common (> 10 daily) in forest at *c.* 2200 m in Mount Elgon NP, 24–25 May.

Grauer's Warbler ***Graueria vittata*** Fairly common by call (5–10 heard daily) at both upper (2200–2400 m) and medium (*c.* 1600 m) elevations in Bwindi Impenetrable NP, 20 March–5 April. One at *c.* 1650 m near Buhoma appeared to be involved in nest construction, returning repeatedly with nesting material to a globular cluster of moss and plant fibres, roughly 10 cm in diameter and positioned in an inaccessible tangle of leaves at the edge of a creeper *c.* 6 m above the ground (JR, SR). A little-known endemic of forests flanking the Albertine Rift Valley (Urban *et al.* 1997).

Grey Longbill ***Macrosphenus concolor*** One seen and tape-recorded in Mabira FR on 12 March and at least six individuals seen (and most tape-recorded) at two sites in Budongo FR (where considered fairly common by JL) from 1–4 May and 12–13 May. One seen at *c.* 700 m in Semliki NP on 16

April (JR) is the first reported for the park. Considered scarce, at 1000–1400 m in Uganda, though present throughout the lowland forest of the adjacent Democratic Republic of Congo (Urban *et al.* 1997). Inconspicuous and easily overlooked until its characteristic song is recognised (pers. obs.).

Lemon-bellied Crombec ***Sylvietta denti*** One heard, seen and tape-recorded along the 'Kirumia Trail' in Semliki NP on 19 April (JR, SR, MW) is the first park record. Infrequently seen but fairly common by call (3–5 daily) in Budongo FR, 1–4 May and 12–13 May. A recent addition to the East African avifauna, considered uncommon and local but "probably under-recorded" (Urban *et al.* 1997).

Brown Parisoma ***Parisoma lugens*** One in Mount Elgon NP on 24 May is the first record for the park, though the species is recorded from the Kenyan side of the mountain. An uncommon and local bird in Uganda, known elsewhere from Kadam, Morungole, Timu, Kasagala and Maruzi forests (FDBR).

Tit-Hylia ***Pholidornis rushiae*** One in Mabira FR on 10 March (MG) and two on 11 March (MG, JR, MS). Until 1980, known in Uganda from only two specimens collected at Mabira, though seen subsequently near Buhoma, Bwindi Impenetrable NP (AR, A. Twinomujuni pers. comm.).

White-tailed Blue Flycatcher ***Elminia albicauda*** Three in Mgahinga Gorilla NP on 28 March, four in Echuya FR on 29 March and fairly common at higher altitudes in Bwindi Impenetrable NP (several daily). Considered local and uncommon (Britton 1980) but apparently fairly common in SW Uganda.

White-bellied Crested Flycatcher ***Trochocercus albiventris*** and **Dusky Crested Flycatcher** ***T. nigromitratus*** These extremely similar species are apparently sympatric at *c.* 1550–1600 m near Buhoma, Bwindi Impenetrable NP. *T. albiventris* is by far the more numerous of the two (certainly much more frequently seen) and is the common small flycatcher accompanying under-storey flocks, both in the forest interior and along the forest tracks. Despite careful observation, typical *T. nigromitratus* was observed on only three occasions between 30 March and 5 April, all in undergrowth within the forest interior and once in the same area as that where a group of *T. albiventris* were present earlier in the day. There were, however, a number of birds that could not be identified, despite good views at close quarters, showing apparently intermediate characters between the two forms. Whether these birds were merely atypical individuals or hybrids could not be established.

Blue-mantled Crested Flycatcher ***Trochocercus cyanomelas*** Despite the author being familiar with its characteristic vocalisations, this species was only recorded once in Bwindi Impenetrable NP during the periods 19–27 March and 30 March–5 April, in a ridge-top thicket at *c.* 2100 m. A local species in Uganda, known only from Bwindi Impenetrable NP, with old records from scattered localities elsewhere in the south (Urban *et al.* 1997).

Pygmy Batis ***Batis perkeo*** A pair seen, heard and tape recorded in the Kidepo Valley, Kidepo Valley NP on 21 May were the only batises encountered in this arid sector of the park. This constitutes the first record of this species for the reserve, previously known in Uganda only from the extreme east near Moroto (where fairly common, pers. obs.) and north of Mt. Elgon (Urban *et al.* 1997).

Ituri Batis ***Batis ituriensis*** On 3 May, near Busingiro, Budongo FR, a 'mystery canopy call' was tape-recorded (JL, JR) and a pair of Ituri Batises responded to playback by calling agitatedly and descending to the mid-storey. Based on its distinctive vocalisation, the species is fairly common in broken forest around Busingiro (at least four pairs/singles on 3 May), although only one pair was encountered in two days in taller, closed-canopy forest along the 'Royal Mile', Budongo FR. Another individual was heard and tape-recorded in secondary forest, Semliki NP on 29 May. This species, a recent addition to the East African avifauna (Ash *et al.* 1991a), is considered rare (Urban *et al.* 1997) but may be found to be more common now that its vocalisations are known.

Pink-footed Puffback ***Dryoscopus angolensis*** Two on each of 10 and 11 March in Mabira FR, and fairly common (2–6 daily) at both higher and medium altitudes in Bwindi Impenetrable NP. Considered uncommon and local in SW Uganda (Britton 1980).

Purple-throated Cuckoo-shrike ***Campephaga quiscalina*** A pair on 10 March (JR, SR, MS) and a male on 11 March in Mabira FR, and a male in Mount Elgon NP on 24 May. Considered uncommon and local (Britton 1980).

Black-winged Oriole ***Oriolus nigripennis***. Only seen once (17 April) in Semliki NP, its only East African locality, where it is an "apparently rare resident" (Britton 1980).

Sharpe's Starling ***Cinnyricinclus sharpii*** A flock of 5 birds in Kibale NP on 26 April (JR, SR, MW) represents the first park record. In south-western Uganda, this highland forest species is restricted to Bwindi Impenetrable NP and the Rwenzori range (Britton 1980) but is known to wander in response to fruiting of trees (Zimmerman *et al.* 1996).

Little Purple-banded Sunbird ***Nectarinia bifasciata*** Several, including immatures, in riparian forest on the south bank of the Victoria Nile opposite Murchison Falls on 4 and 5 May. Only known from "scattered records" in western Uganda (Britton 1980).

Rufous Sparrow ***Passer rufocinctus*** Two pairs in Murchison Falls NP on 6 and 7 May represent a westward extension of this widespread species' range. Previously known in Uganda from scattered localities in the north-east (Britton 1980).

Fox's Weaver ***Ploceus spekeoides*** Four on the northern bank of Lake Opeta (1°39′ N, 34°10′ E) on 26 May. A Ugandan endemic with a very restricted range (Britton 1980).

Yellow-crowned Bishop ***Euplectes afer*** A male in breeding plumage on the Semliki Flats (1°00′ N, 30°30′ E) on 25 April. Considered scarce and local (Britton 1980).

Southern Red Bishop ***Euplectes orix*** Extends north to at least 0°50′ N, 30°15′ E in Semliki WR, where common and sympatric with the equally numerous Northern Red Bishop *E. franciscanus*. These two species are usually considered allopatric (Britton 1980).

Red-fronted Antpecker ***Parmoptila woodhousei*** A pair on 4 April (MG) and a pair, probably the same birds, on 5 April (JR) in Bwindi Impenetrable NP, a pair on 22 April and a single on 31 May in Semliki NP. An uncommon resident, known elsewhere in Uganda only from Budongo, Kibale and Kalinzu forests (Britton 1980).

Grey-headed Olive-back ***Nesocharis capistrata*** One on 2 May (JL, JR) and a pair on 13 May (JR) near Busingiro, Budongo FR. An uncommon and local resident (Britton 1980).

Shelley's Crimsonwing ***Cryptospiza shelleyi*** A pair at 2525 m in Bwindi Impenetrable NP on 20 March. An uncommon resident, known elsewhere in Uganda from the Rwenzoris (Britton 1980).

Dusky Twinspot ***Euschisctospiza cinereovinacea*** One at 2250 m at the edge of Bwindi Impenetrable NP on 25 March (JR, SR). This scarce resident is known elsewhere in Uganda from Lake Chahafi (Britton 1980).

Magpie Mannikin ***Lonchura fringilloides*** Two outside the borders of the park near Buhoma, Bwindi Impenetrable NP on 1 April (JR) and two in Semliki NP on 21 April (JR). This scarce and local species is known from previous records in the Semliki NP but is not known from within Bwindi Impenetrable NP (Britton 1980).

Straw-tailed Whydah ***Vidua fischeri*** A transitional plumaged male in Kidepo Valley NP on 21 May confirms the previous record(s) for the park.

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Altitudinal distribution and abundance patterns of bird species in the Eastern Arc Mountains, Tanzania

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The Eastern Arc Mountains of Tanzania are known as one of the worlds 'hot spots' for endemism and as an important focal area for the protection of birds (Burgess *et al.* 1998, Collar & Stuart 1988, Stattersfield *et al.* 1998). This species-rich archipelago of montane forests has been subject to a growing number of ornithological studies, and many aspects of species diversity (e.g. Stuart *et al.* 1993, Fjeldså & Rabøl 1995, Cordeiro 1998) and patterns of speciation and endemism (Fjeldså & Lovett 1997, Roy *et al.* 1997) have recently been analysed on a regional scale. The biodiversity riches of these unique forests have caused attention to be focused on identifying conservation priorities and preventing further degradation of the most important forest reserves (e.g., Hamilton & Bensted-Smith 1989, Newmark 1991, 1998, Rodgers 1993, Seddon *et al.* 1999).

Despite this interest many aspects of the forest bird communities remain unknown. Knowledge of the biogeography and altitudinal preferences of individual Eastern Arc species is generally limited to geographical and (to some extent) altitudinal distribution. A number of publications have also included notes on abundances at various altitudes (Sclater & Moreau 1932, Moreau 1940, Stuart *et al.* 1987, Jensen & Brøgger-Jensen 1992, Dinesen *et al.* 1993, Moyer 1993, Cordeiro 1994, Svendsen & Hansen 1995), summarised in the standard works of Britton (1980) and the 'Birds of Africa' series (Brown *et al.* 1982, Fry *et al.* 1988, Urban *et al.* 1986, 1997, Keith *et al.* 1992).

However, comparative studies that incorporate standardised measures of abundance are rare and cover only a few sites (Evans & Anderson 1993, Fjeldså *et al.* 1997, Fjeldså 1999, Seddon *et al.* 1999). This paper attempts to describe the abundance patterns of Eastern Arc bird species as a function of entire elevational gradients. The idea of 'mapping' the abundance of individual species according to altitude is not new. Terborgh (1971) used this approach to illustrate the relative importance of competition and ecotones in Andean birds. Able & Noon (1976) applied it to competing congeners in north-east America. To my knowledge, however, this is the first time that the altitudinal abundance patterns of an entire bird community have been documented in Africa.

Study area

The Eastern Arc Mountains stretch from the Taita Hills in south-east Kenya through Tanzania to the Makambako Gap south-west of the Udzungwa Mountains (Figure 1) (Lovett 1990, Stattersfield *et al.* 1998). Avifaunally, however, the Taita Hills constitute a distinct biogeographical unit (Stuart *et al.* 1993, Brooks *et al.* 1998, Cordeiro 1998); they are not considered further in this paper.

The mountains are fault blocks of crystalline rock, shaped through tens of millions of years with a final uplift 7 million years ago (Griffiths 1993). The direct climatic influence of the Indian Ocean, which continually sends warm humid air currents over the escarpments, characterises the Eastern Arc ecosystems. This predictability has allowed persistence of the unique forests covering the mountains (Lovett 1993). The mountain peaks reach 2200–2600 m in elevation, and were originally completely forest clad. The Eastern Arc forest type is a combination of Afromontane rain forest and Zanzibar-Inhambane transitional or lowland forest (Lovett 1990). Altitudinal change in forest composition is very gradual and boundaries between montane, submontane and lowland zones are mainly applied by convention (Lovett 1993, 1996).

Four different mountain ranges were visited in 1995–96 and 1996–97 at the end of the dry season (around November–December). This corresponds to the beginning of the breeding period (Moyer 1993), and thus most species are expected to be in their breeding habitat. The areas visited were all on east-facing escarpments. The habitat information below was taken from Collar & Stuart (1988), Jensen & Brøgger-Jensen (1992), Lovett & Pócs (1993), Fjeldså & Rabøl (1995), Svendsen & Hansen (1995), Lovett (1996) and Fjeldså (1999) as well as my own observations. The study areas were:

1 Udzungwa Scarp Catchment Forest Reserve in the Udzungwa Mountains. With around 500 km² of forest the Udzungwas have by far the largest forested area in the Eastern Arc and, together with the Usambaras, are the range richest in species. Udzungwa Scarp is the south-eastern part of the range and at 230 km² it is the largest single forest block in the Eastern Arc. The unbroken forest gradient extends from 300 m to around 2100 m, but the lowest elevations are degraded. Annual rainfall is around 2500 mm. Data were collected in December 1995 and January 1996, from seven sites between Chita, on the edge of the Kibashira swamps, and the villages of Uhafiwa and Masisiwe in the highlands. The highest site (2030 m) was in a bamboo zone with remnants of montane forest interspersed.

2 Nguru South Forest Reserve. This reserve holds 120 km² of forest from 500 m to 2400 m, of which the lowest forest is degraded and somewhat fragmented. Annual rainfall varies from 1200 mm to 4000 mm at the highest altitudes (Lovett & Pócs 1993). The study area was in the northern part of the reserve, north of Mhonda Mission. Six sites were

visited along an altitudinal gradient from 860 m to 1950 m in December 1996.

3 Uluguru North Forest Reserve, which comprises 84 km² of primary forest from around 1100 m to at least 2200 m. Annual rainfall on the eastern slopes ranges from 2900–4000 mm, and no months receive less than 100 mm. This makes it the most perhumid forest in the Eastern Arc. Data were collected in November 1996 from four sites on a gradient above the eastern village of Tegetero.

4 The South Pare Mountains, of which the central part (centred on Mt Shengena) holds 143 km² of forest, but is heavily disturbed from both the east and the west sides. Forest cover starts around 1400 m, but is mostly fragmented at lowest altitudes. The peak (2465 m) is covered with elfin forest. Annual rainfall is 1500–3000 mm, probably the highest in the Pare chain, which is in the rain shadow of the Usambaras. Data were collected in December 1996 and January 1997 at three sites crossing from Chome in the west to Gonja village in the east.

Methods

Relative abundance data were obtained by random walking on paths and other 'leading lines' where quiet walking is possible. Observations were made in a 1-km² site, as described in Fjeldså (1999). Altitude was measured with Avocet and Eschenbach altimeters. Because of the steep terrain altitude was allowed to deviate by 50 m within the site. An effort was made to cover each part of the observation site equally and at all hours of the day. Each observed (seen or heard) individual bird was recorded, and observations were made throughout the day. This is necessary to observe both dawn-singing skulkers and sun-loving canopy-species like sunbirds or tinkerbirds. Therefore, from the community of resident species owls were the only group not represented. A standard of 500 individual observations was obtained from each site, though only 450 were recorded at 2030 m on the Udzungwa Scarp in a bamboo zone with very few birds.

Density data are from 10-minute counts of all individuals (of all species) in 1-hectare plots in peak activity hours 06:00 to 09:00 and 16:00 to 18:00 (Koen 1988). An effort was made to record all birds present in the plot, thereby providing a measure of density. Twenty-five plots (25 ha) were covered at each site and density estimates extrapolated to number of individuals per km² (100 ha).

Further details on methodology are given in Romdal (1998). Taxonomy and nomenclature generally follows Dowsett & Forbes-Watson (1993), though complemented by Keith *et al.* (1992) and Urban *et al.* (1997) where opinions diverge. Other deviations are recognition of South Pare White-eye *Zosterops winifredae* (as in Collar *et al.* 1994) and Black-fronted Bush-shrike *Malaconotus nigrifrons* (as in Zimmerman *et al.* 1998). The systematic order follows Dowsett & Forbes-Watson (1993).

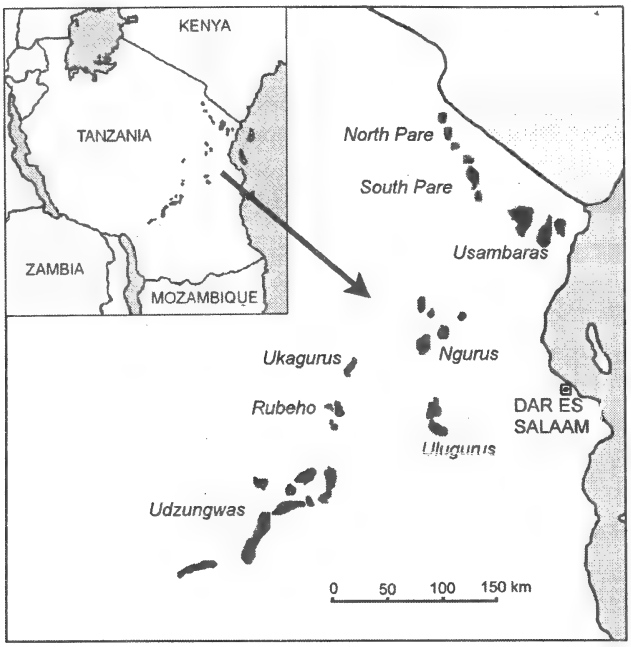


Figure 1. The Eastern Arc Mountain chain of Tanzania. Shaded areas are forested mountain ranges. The four areas visited were Udzungwas, Ulugurus, Ngurus and South Pare Mountains.

Results

Densities

The altitudinal distribution and relative abundance of each species are given in Appendix 1.

The highest overall bird densities were found at mid-altitude, around 1500 m (Table 1). Individual densities (calculated from relative species abundance and overall density, and combined for all four gradients) for the common Eastern Arc species are shown in Figure 2. Typical lowland species such as Red-capped Robin *Cossypha natalensis* and White-throated Nicator *Nicator gularis* are clearly differentiated from montane species such as Eastern Mountain Greenbul *Andropadus nigriceps* and Evergreen Forest Warbler *Bradypterus lopezi*.

Many species showed similar patterns on all the four gradients. An example is White-starred Robin *Pogonocichla stellata* (Figure 3a). The species is montane, but is found below 1500 m in small numbers. In other cases, there were variations that are concealed by the combined curves in Figure 2. The South Pares were particularly distinct in species abundance patterns as well as species composition (see discussion). For example, Bronze-naped Pigeon *Columba delegorguei* (Figure 3b) showed great variation between sites, and occurred at very low densities in the South Pares. (In fact, all three columbid species present in the South Pares were uncommon, perhaps because they depend on intact moist forest while the forest there is relatively degraded.)

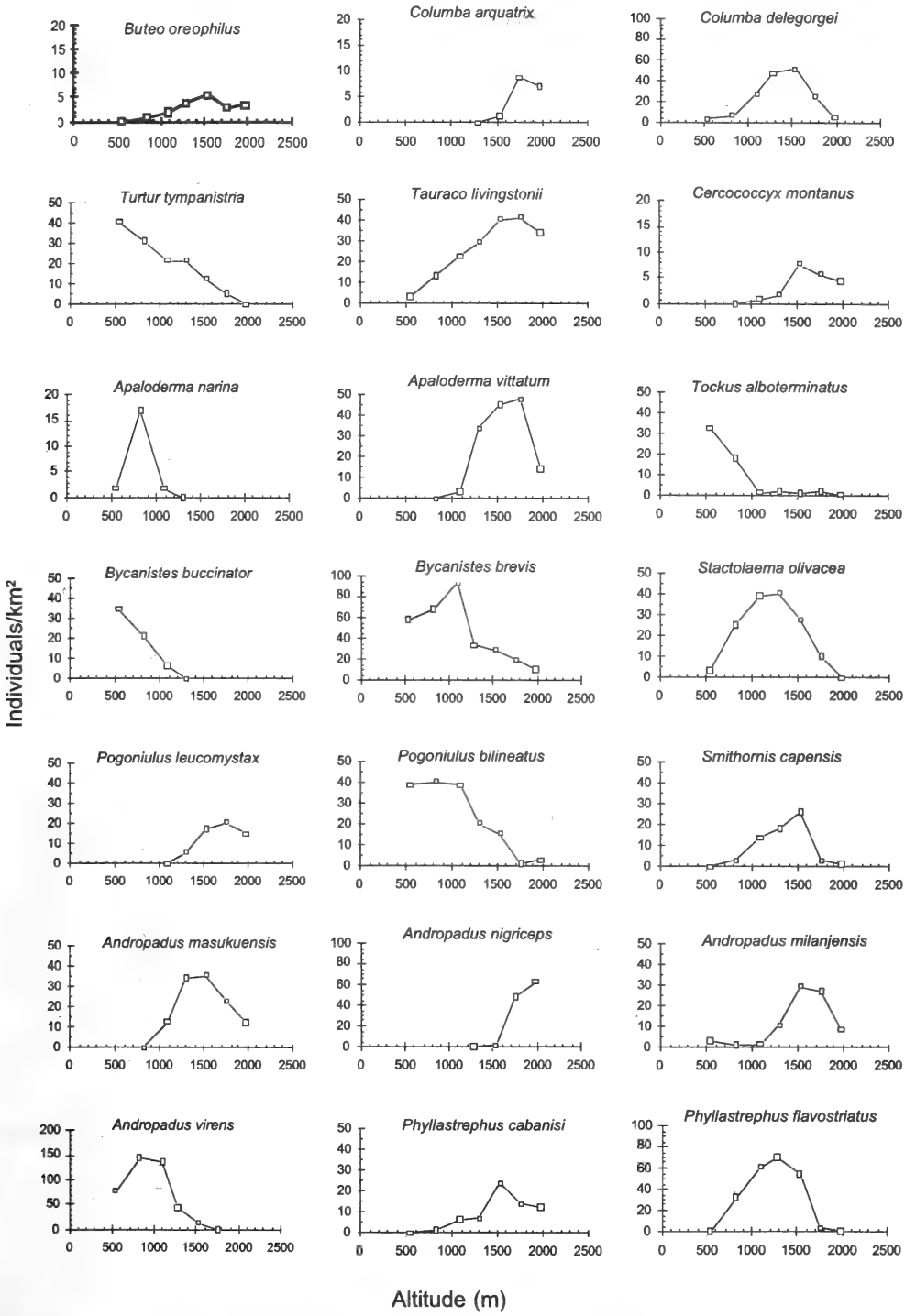
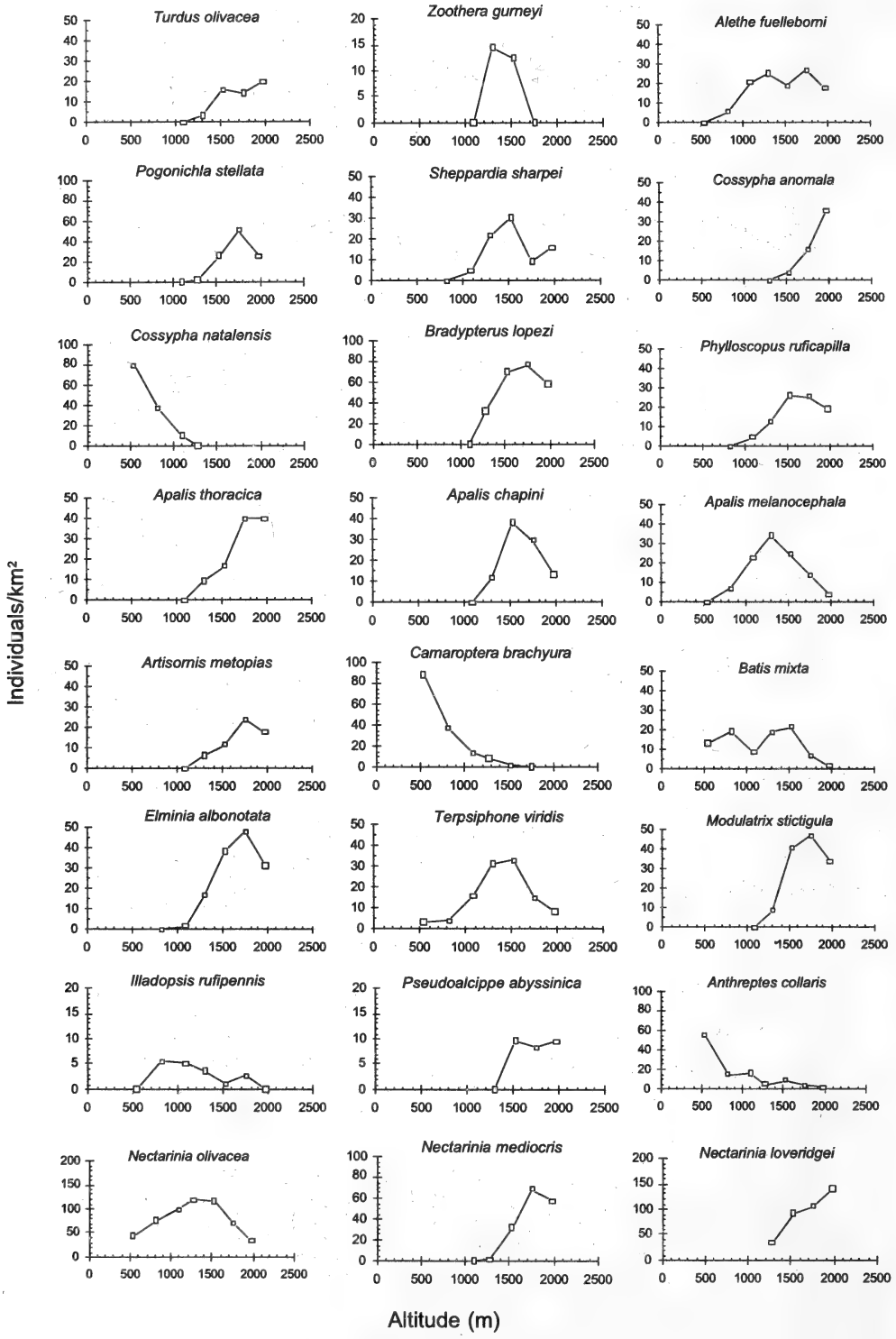


Figure 2. The abundance curves for all common Eastern Arc forest species. The x-axis shows altitude (m) and the y-axis individuals/km². The scale on the y-axis varies. The curves in this figure represent averaged values from all gradients where the species is present.



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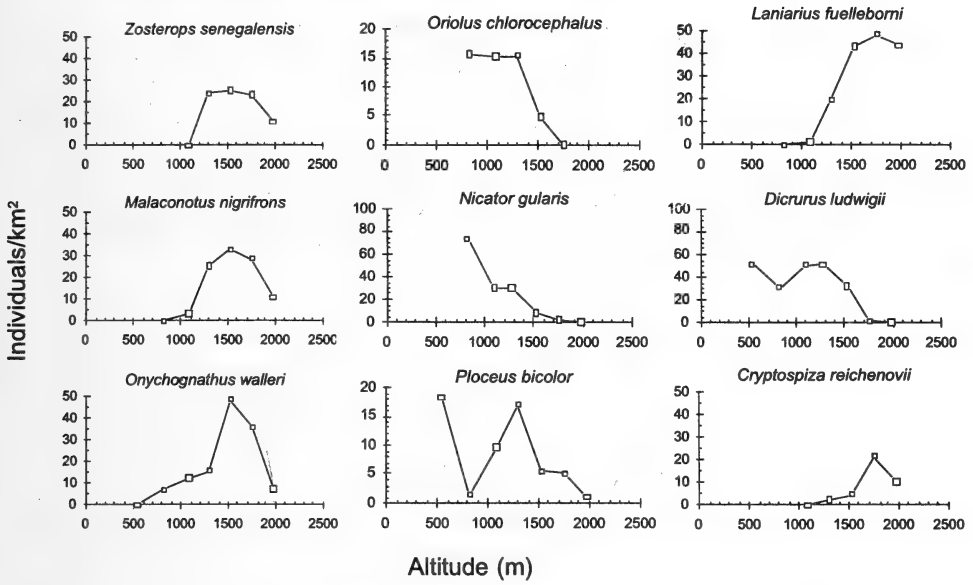

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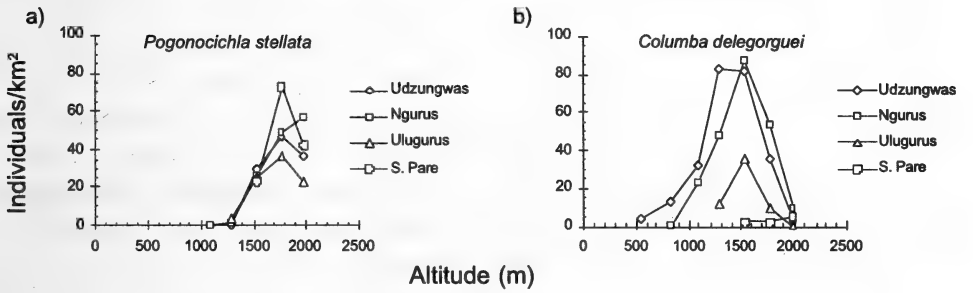

Figure 3. Examples of unmerged abundance curves, showing abundance patterns for each of the four gradients: (a) White-starred Robin *Pogonocichla stellata;* (b) Bronze-naped Pigeon *Columba delegorguei*

Patterns among related species

The patterns of related and possibly competing species are interesting to compare. Hartlaub's Turaco *Tauraco hartlaubi* replaces Livingstone's Turaco *Tauraco livingstonii* in South Pare and other northern ranges, but the abundance patterns of the two species are remarkably similar (Figure 4a). In contrast, while Yellow White-eye *Zosterops senegalensis* is generally a common montane species, South Pare White-eye *Zosterops (poliogaster) winifredae* has succeeded in becoming extremely abundant in the South Pares, its only locality (Figure 4b). Eastern Double-collared Sunbird *Nectarinia mediocris* and Loveridge's Sunbird *Nectarinia loveridgei* are sister species, with *N. loveridgei* endemic to the Ulugurus. The distinctive Moreau's Sunbird *N. (mediocris) moreaui* is probably also a full species (e.g., Collar *et al.* 1994). I found *N. (m.) moreaui* in the Ngurus and South Pares, and nominate *N. mediocris* in the

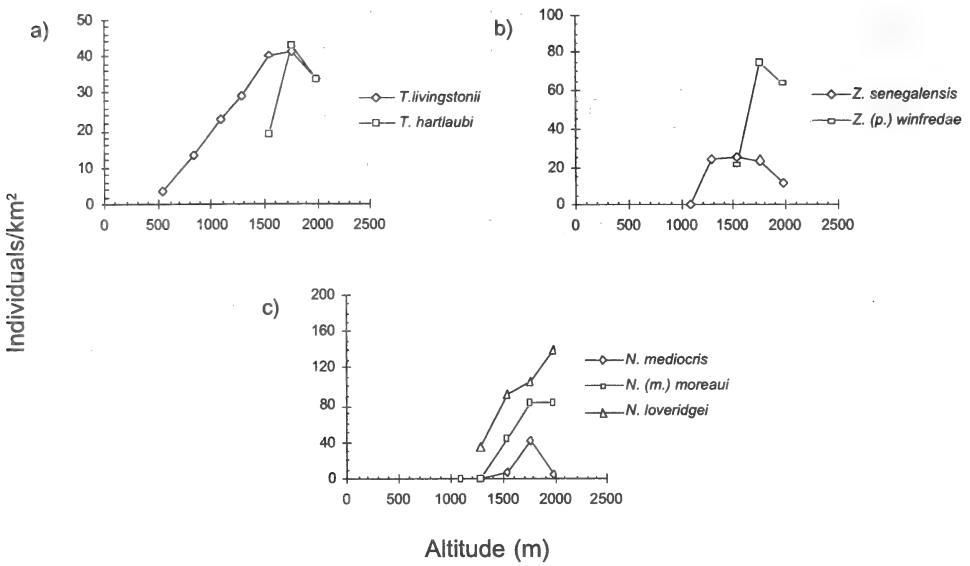

Figure 4. Examples of comparison of abundance patterns of congeneric species in separate mountain ranges: (a) Livingstone's Turaco *Tauraco livingstonii* (data combined from Udzungwas, Ngurus and Ulugurus) and Hartlaub's Turaco *T. hartlaubi* (South Pares only); (b) Yellow White-eye *Zosterops senegalensis* (Udzungwas, Ngurus and Ulugurus) and South Pare White-eye *Z. (poliogastra) winifredae* (South Pares only); (c) Eastern Double-collared Sunbird *Nectarinia mediocris* (Udzungwas), Moreau's Sunbird *N. (mediocris) moreaui* (Ngurus and South Pares) and Loveridge's Sunbird *N. loveridgei* (Ulugurus).

Table 1. Overall densities of individual birds at each altitude. In order to present all densities in the same table, nearby altitudes have been lumped. Exact altitudes can be found in Appendix 1

	Density (birds/km²)			
Altitude (m)	Udzungwas	Ngurus	Ulugurus	South Pare
500	916	–	–	–
800	704	776	–	–
1100	896	832	–	–
1300	1252	856	932	–
1500	1244	1224	1168	1052
1700	928	1060	1128	1136
2000	604	800	760	844

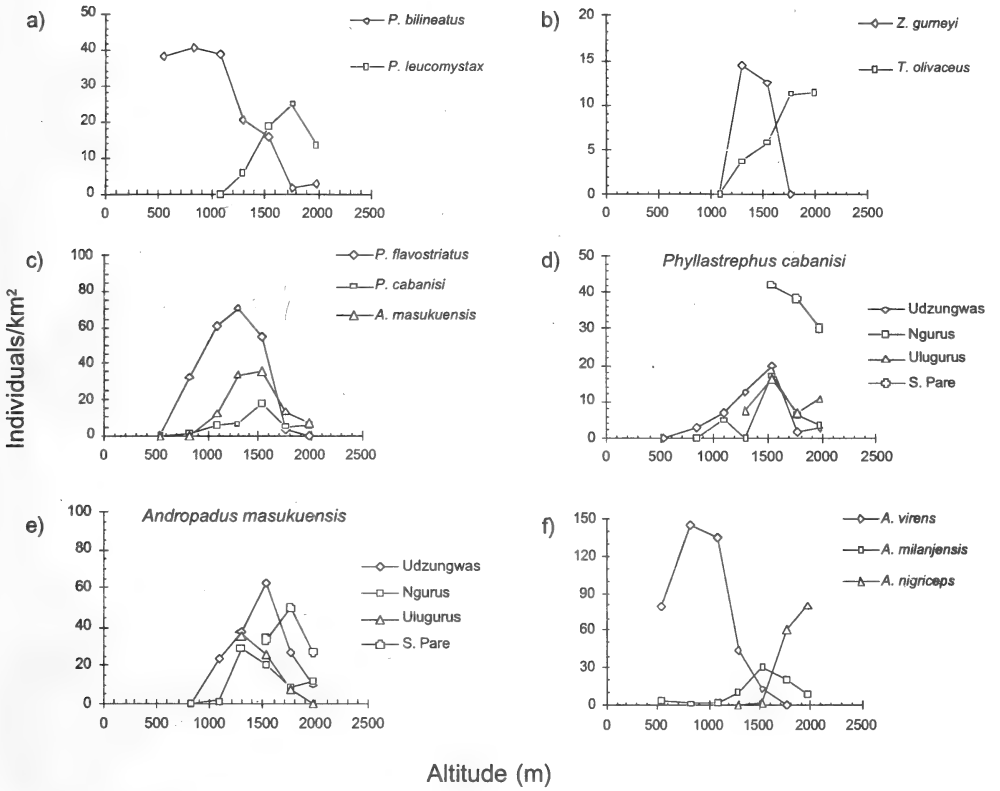

Figure 5. Examples of co-occurrence of closely related species. Data are combined only for the gradients where the species occur together: (a) Yellow-rumped Tinkerbird *Pogoniulus bilineatus* and Moustached Green Tinkerbird *P. leucomystax* (Udzungwas, Ngurus and Ulugurus); (b) Orange Thrush *Zoothera gurneyi* and Olive Thrush *Turdus olivaceus* (Udzungwas and Ulugurus); (c) Yellow-streaked Greenbul *Phyllastrephus flavostriatus*, Cabanis's Greenbul *P. cabanisi* and Shelley's Greenbul *Andropadus masukuensis* (Udzungwas, Ngurus and Ulugurus); (d) *P. cabanisi* on each of the four gradients; (e) *A. masukuensis* on each gradient; (f) Little Greenbul *Andropadus virens*, Stripe-cheeked Greenbul *A. milanjensis* and Eastern Mountain Greenbul *A. nigriceps* (Udzungwas, Ngurus and Ulugurus).

Udzungwas. All three are montane (Figure 4c). The Udzungwa population differs from the others in being uncommon at 2030 m (the census there was centred on bamboo forest, an unfavourable habitat). Apart from that the curves are similar, with the endemic *N. loveridgei* being by far the most common of the three, a parallel to the localised success of *Zosterops winifredae*.

Effects of competition

Competition might limit altitudinal ranges in some cases (Figures 5 and 6). The two tinkerbird species (Figure 5a) are both food generalists, but with a

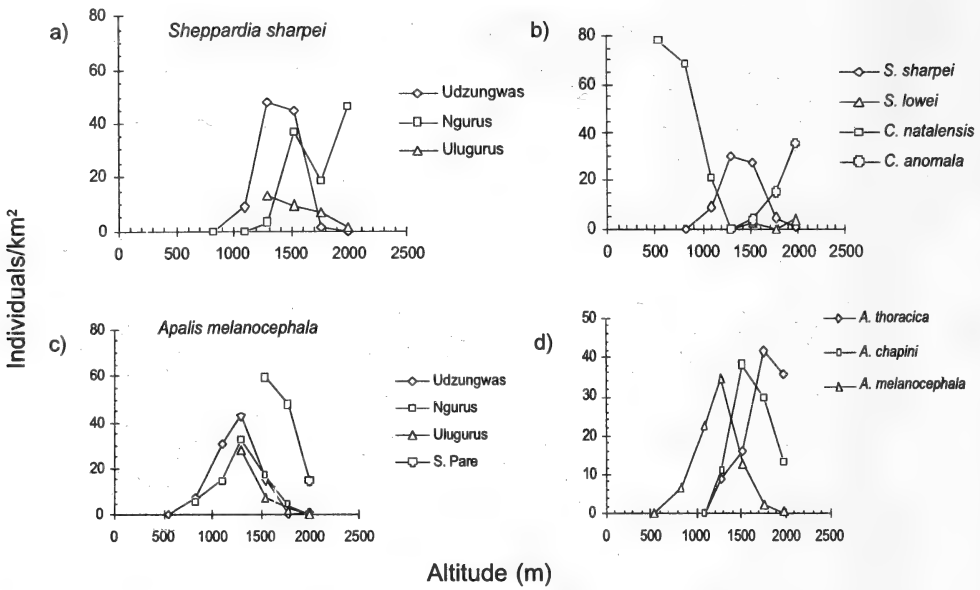

Figure 6. Examples of altitudinal shifts: (a) Sharpe's Akalat *Sheppardia sharpei* (for each gradient where it occurs); (b) *S. sharpei* with Olive-flanked Robin *Cossypha anomala* (combined from Udzungwas and Ulugurus, where they co-occur); Red-capped Robin *C. natalensis* (from Udzungwas, where it co-occurs with the two previous species) and Iringa Akalat *S. lowei* (also from Udzungwas); (c) Black-headed Apalis *Apalis melanocephala*; (d) *A. melanocephala* compared with Bar-throated Apalis *A. thoracica* and Chapin's Apalis *A. chapini* (from Udzungwas, Ngurus and Ulugurus, where the three species co-occur).

Table 2. Extensions to the (approximate) altitudinal ranges found in the literature for East Africa

Species	New records		Range in literature (m)	Comment
	Altitude	Site		
Buteo oreophilus	1100	Udzungwas	1270–3800	Near sea level in Southern Africa
	860	Ngurus		
	1240	Ulugurus		
Andropadus milanjensis	540	Udzungwas	800–2145	Migrant to low altitudes in cold season (Burgess & Mlingwa 2000)
Phyllastrephus debilis	1550	Ngurus	0–1500	
Apalis melanocephala	2030	Udzungwas	0–2000	
Illadopsis rufipennis	1780	Udzungwas	0–1700	
Malaconotus alius	1240	Ulugurus	1300–2100	Very few records
Onychognathus walleri	800	Udzungwas	900–3000	Altitudinal migrant (Burgess & Mlingwa 2000)

preference for mistletoe berries (Jon Fjeldså, pers. comm.). They are typical canopy species and very hard to observe, but both often attend drongo feeding parties. Yellow-rumped Tinkerbird *Pogoniulus bilineatus* is common

at low altitudes, Moustached Green Tinkerbird *P. leucomystax* only at higher altitudes. The two large thrushes, Orange Ground Thrush *Zoothera gurneyi* and Olive Thrush *Turdus olivaceus*, are very similar and are known to compete for food items (Earlé & Oatley 1983). Although they overlap, *Z. gurneyi* is distinctively sub-montane and *T. olivaceus* montane (Figure 5b).

The six common greenbul species have different feeding strategies, with three being mainly or exclusively insect eaters and three having a mixed diet of mainly fruits and berries (described in Dinesen 1997). The two *Phyllastrephus* species are similar and both specialise in searching the vegetation for insects. However, they are segregated mainly by foraging stratum, not altitudinally. Yellow-streaked Greenbul *P. flavostriatus* is found in the canopy, while Cabanis's Greenbul *P. cabanisi* forages on the forest floor and in the understorey. Meanwhile Shelley's Greenbul *Andropadus masukuensis* has specialised in collecting insects from the trunks and branches of trees like a woodpecker, thereby occupying a separate niche. These three species overlap broadly, with *P. flavostriatus* being the most sub-montane (Figure 5c). In the South Pares, where *P. flavostriatus* is absent, *P. cabanisi* and to a lesser extent *A. masukuensis* are particularly common, suggesting some competitive release (Figures 5d and 5e). The three remaining *Andropadus* species have broad diets and are found mainly in the lower strata. They are likely competitors for berries and fruits, and their populations are centred on distinct altitudinal zones (Figure 5f).

Another example of altitudinal exclusion could be Narina Trogon *Apaloderma narina* and Bar-tailed Trogon *A. vittatum* (Figure 2).

Niche shifts

Figure 6 shows two examples where niche shifts through competitive release may have occurred. The averaged data for Sharpe's Akalat *Sheppardia sharpei* suggest it is predominantly sub-montane, peaking around 1500 m. However, when the different populations are viewed together (Figure 6a), it is obvious that the Nguru population is montane (i.e., very common above 1600–1700 m), while Udzungwa and Uluguru populations are more submontane. Figure 6b shows the abundance pattern of *S. sharpei* and of three potential competitors: Iringa Akalat *S. lowei*, Olive-flanked Robin *Cossypha anomala* and Red-capped Robin *C. natalensis*. These are all understorey species and potentially compete for food, especially insects. The two *Cossypha* species are decidedly lowland (*natalensis*) and montane (*anomala*), respectively, and do not overlap. The distribution of *S. sharpei* appears to be intermediate between them. I found very few *S. lowei* in the Udzungwas, which is the only locality for the species in this survey, but it is strictly montane, mainly found at altitudes above *sharpei* (Keith et al. 1992). Evidently the absence of *S. lowei* does not result in *S. sharpei* becoming commoner at high altitudes in the Ulugurus. However, in the Ngurus both *C. anomala* and *S. lowei* are absent, leaving the 'montane small understorey thrush' niche vacant for *S. sharpei* to occupy.

A parallel is seen in the Nguu Mountains, where none of these four thrush species is found. Instead, the coastal lowland species East Coast Akalat *Sheppardia gunningi* is common at all altitudes (Seddon *et al.* 1999). These findings suggest that the *Sheppardia* and *Cossypha* thrushes are in fact competitors.

The South Pare population of Black-headed Apalis *Apalis melanocephala* is strikingly distinct in distribution (Figure 6b), being abundant at montane altitudes. In the other three sites, its pattern of abundance is very similar to those of both its most common congeners, Bar-throated Apalis *A. thoracica* and Chapin's Apalis *A. chapini* (Figure 6c). Of the three, *A. melanocephala* is the least montane, being uncommon above 1500 m. Apalises are quite similar in ecology, but competition should be mainly between *A. melanocephala* and *A. chapini*, as they are both confined to the canopy (see also Urban *et al.* 1997). As *A. chapini* is lacking in the South Pares, that is the probable factor allowing *A. melanocephala* to expand its niche to higher altitudes there.

New altitudinal records

The full altitudinal range of each species is not fully described in a relatively short study like the present one. Some species are recorded to have wider altitudinal ranges in the Eastern Arc forests (Jensen & Brøgger-Jensen 1992, Svendsen & Hansen 1995). Nevertheless, a few records (Table 2) were extensions of known altitudinal range (see Britton 1980, Brown *et al.* 1982, Urban *et al.* 1986, Fry *et al.* 1988, Jensen & Brøgger-Jensen 1992, Keith *et al.* 1992, Svendsen & Hansen 1995, Urban *et al.* 1997).

Distribution patterns among ranges

Appendix 1 shows which species are 'missing' from one particular range while shared among the three others. There are 18 'missing' species in the South Pares, one each in the Ngurus and Ulugurus and none in the Udzungwas. The 'missing' species in the South Pares includes a number of typical Eastern Arc montane species such as *Tauraco livingstonii*, Grey Cuckoo Shrike *Coracina caesia*, *Apalis chapini*, African Tailorbird *Artisornis metopias*, Spot-throat *Modulatrix stictigula*, *Zosterops senegalensis* and Fuelleborn's Black Boubou *Laniarius fuelleborni*. On the other hand, northern species such as *Tauraco hartlaubi* and *Zosterops winifredae* were only found in South Pares.

Discussion

The random-walking method used for this study is a highly rewarding and time-efficient method for obtaining data on species richness, distribution and abundance (Fjeldså 1999). Most sites were surveyed in 3 or 4 days, although more time was required in areas of low bird density. Alternatively one could standardise the effort in terms of data-collecting hours spent walking, but the amount of data will then be very sensitive to weather-induced variations in bird activity.

Actual spot-mapping is the superior method for determining exact densities of individual species, but this will require several weeks spent at each site (Anonymous 1970, Bibby *et al.* 1992). The Udzungwa spot-mapping census of Moyer (1993) suggests that my density measurements in timed counts severely underestimated actual density. My maximum estimate was 626 pairs (1252 individuals) per km^2, while Moyer (1993) found 1710 pairs per km^2 at 1450 m in Udzungwa Scarp Forest Reserve. Even though territory mapping can overestimate density when territory holders are assumed to represent a pair or when birds move around, it is the most accurate measure available. The figures presented here should therefore be interpreted as relative, showing the interspecific and altitudinal variation rather than absolute density. Nevertheless, when data on distribution and relative species abundance are needed, a form of random-walking method is recommendable considering the trade-off of data obtained and time spent in the field.

The Eastern Arc spans seven latitudinal degrees and consequently considerable climatic and geographic variations occur. Climatic differences cause variation in the altitudinal span of vegetation belts (Lovett 1993), presumably influencing the ranges of bird species. In this study the South Pares stood out from the other ranges. A number of species had quite different abundance patterns here than in the other sites. In addition, the South Pares lacked many species found in all the other sites. Some of these might have gone locally extinct due to sub-montane habitat loss, but many were true montane forest birds characteristic of the Eastern Arc avifauna. Avifaunally, the South Pares thus seem quite removed from the other sites studied here — as Brooks *et al.* (1998) found for the Taita Hills. A rigorous test of similarities of the complete Eastern Arc avifaunas would be profitable at this time (see also Cordeiro 1998).

The mid-altitude peak of density parallels the peak of species richness on the same gradients (Romdal 1998). This richness pattern is often found on altitudinal gradients, even though traditionally it has been assumed that richness decreases monotonically with altitude (Rahbek 1995). Terborgh (1977) also found mid-altitude peaks for both density and richness in the Andes. One possible explanation is that a zone on the escarpments continuously captures moisture from the humid air meeting the forest, maintaining a high year-round primary productivity that supports many species as well as a high bird density (Jensen & Brøgger-Jensen 1992, Lovett 1993).

Many species' altitudinal ranges extend over most of the gradient, with individual abundance peaks scattered across a range of altitudes. This makes it difficult to delimit communities in intermediate zones: the transition from the lowland to the montane community is gradual. Meanwhile, the graphs suggest some cases of altitudinal replacement of congeners. Historically, these altitudinal segregations could be produced by congeneric competition or by original habitat adaptations of the individual species, or both (Wiens

1989). However, presently competition may control the altitudinal ranges as indicated by the examples of altitudinal shifts.

The primary value of the abundance curves lies in the fact that they clearly show which part of the gradient is most important for each individual species. Many species are known to undertake altitudinal migration in the dry season (Burgess & Mlingwa 2000), but as all my records are from the breeding period the results show the favoured breeding habitat. The range of distributions shows that all parts of the gradient are important for the preservation of forest birds. The considerable variation in abundance demonstrated here possibly reflects 'source' and 'sink' habitat at different altitudes (Pulliam 1988). However, to identify the sources and sinks accurately would require exhaustive data on demography and dispersal (Diffendorfer 1998). The ongoing destruction of forest habitat in the Eastern Arc (through land clearing and timber extraction) is most intense in the lowest parts. This would make species that have their source habitat at lower elevations particularly vulnerable, even when they are also found at higher altitudes. Examples of such species could be *Pogoniulus bilineatus*, Green Barbet *Stactolaema olivacea*, African Broadbill *Smithornis capensis*, Square-tailed Drongo *Dicrurus ludwigii*, *Phyllastrephus flavostriatus*, *Apalis melanocephala* and Dark-backed Weaver *Ploceus bicolor*. Of these, only *Apalis melanocephala* is found in the South Pare Mountains, although suitable habitat is present for all seven. This might be because the lower part of the South Pare gradient is now almost without forest. The recognition of source habitat dependence is obviously crucial for conservation, as preserving sink habitat alone will lead to eventual extinction.

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Appendix 1. All records of forest birds by mountain range. All numbers are individuals in a sample of 500 (except at 2030 m on the Udzungwa Scarp where the sample was of 450 individuals). The figures at the top of each column show altitude in metres. Records are from standardised counts except when indicated by '+'.

Species		Udzungwa Scarp							Ngurus						Ulugurus						
		540	800	1100	1340	1520	1780	2030	860	1070	1280	1550	1750	1950	1240	1480	1720	1930	1580	1780	2010
African Goshawk	*Accipiter tachiro*				1	1			+	1	3		1		+		+		1	1	1
Forest Buzzard	*Buteo oreophilus*			2	1	1	4	4	1		1	3	1	1	4	5		3		1	
Crowned Eagle	*Stephanoaetus coronatus*		3	1	+	2					2		1				+	2	1	2	2
Crested Guineafowl	*Guttera pucherani*								13	2											
Olive Pigeon	*Columba arquatrix*						2	12					9	4		2	5	4		1	1
Bronze-naped Pigeon	*Columba delegorguei*	2	9	18	33	33	19	2		14	28	36	25	6	6	15	4	+	1	1	3
Lemon Dove	*Aplopelia larvata*				1					1					3	1	7	17	2		5
Tambourine Dove	*Turtur tympanistria*	22	26	16	16	9			17	9	14	6	2				5	+			
Livingstone's Turaco	*Tauraco livingstonii*	2	1	8	12	16	21	27	16	19	21	21	19	24	12	13	20	21			
Hartlaub's Turaco	*Tauraco hartlaubi*																		9	19	20
Red-chested Cuckoo	*Cuculus solitarius*																		4	1	
Barred Longtailed Cuckoo	*Cercococcyx montanus*					4	2			1	2	8	7	5	1		2	6	1		
Klaas's Cuckoo	*Chrysococcyx klaas*											+		+	1	2					
Green Coucal	*Ceuthmochares aereus*	1	4						3												
White-browed Coucal	*Centropus superciliosus*	12	3					4	19	3		1				1			2		
African Wood Owl	*Strix woodfordii*		+		+					+					+		+			+	
Narina Trogon	*Apaloderma narina*	1	12	1																	
Bar-tailed Trogon	*Apaloderma vittatum*			4	14	14	7	6			28	39	32	18	9	19	23	3	2	26	10
Cinnamon-breasted Bee-eater	*Merops oreobates*																			1	
Crowned Hornbill	*Tockus alboterminatus*	18	13	1	1		1												1	1	1
Trumpeter Hornbill	*Bycanistes buccinator*	19	21	6					8	1											
Silvery-cheeked Hornbill	*Bycanistes brevis*	32	79	88	9	8	7	5	15	17	15	2	1		28	14	17	2	27	11	18
White-eared Barbet	*Stactolaema leucotis*																		2		
Green Barbet	*Stactolaema olivacea*	2	1	4	2	2			31	43	38	14	10		28	19	4				
Moustached Green Tinkerbird	*Pogoniulus leucomystax*				3	4	13	2				1	9	14	5	19	14	10	5	3	11
Yellow-rumped Tinkerbird	*Pogoniulus bilineatus*	21	41	17	5	11			15	28	10	4	2	5	17	4					
Scaly-throated Honeyguide	*Indicator variegatus*			1	+					4	1				2						
Green-backed Honeyguide	*Prodotiscus zambesiae*		1																		

Species		Udzungwa Scarp							Ngurus						Ulugurus						
		540	800	1100	1340	1520	1780	2030	860	1070	1280	1550	1750	1950	1240	1480	1720	1930	1580	1780	2010
Golden-tailed Woodpecker	*Campethera abingoni*	1																			
Cardinal Woodpecker	*Dendropicos fuscescens*			3	2										+						
Olive Woodpecker	*Mesopicos griseocephalus*						1								1	1					
African Broadbill	*Smithornis capensis*		2	7	13	7	2	3	2	9	8	9	2		4	17					
Black Saw-wing	*Psalidoprocne pristoptera*				+		3														
Mountain Wagtail	*Motacilla clara*						1														
Black Cuckoo Shrike	*Campephaga flava*									2											
Grey Cuckoo Shrike	*Coracina caesia*			2			2			+		1	1		2		2				
Shelley's Greenbul	*Andropadus masukuensis*			13	15	25	14	8		1	17	8	4	7	19	11	3		16	22	16
Eastern Mountain Greenbul	*Andropadus nigriceps*					2	47	39					25	77			19	47		3	6
Striped-cheeked Greenbul	*Andropadus milanjensis*	2	2	2	1	16	14	12			5	6	11	7	11	16	5		13	21	5
Little Greenbul	*Andropadus virens*	43	44	49	30	16			148	109	10				22						
Yellow-bellied Greenbul	*Chlorocicla flaviventris*	2	3																		
Fischer's Greenbul	*Phyllastrephus fischeri*	8																			
Cabanis's Greenbul	*Phyllastrephus cabanisi*		2	4	5	8	1	2		3	2	7	3	2	4	7	3	7	20	17	18
Yellow-streaked Greenbul	*Phyllastrephus flavostriatus*			23	50	26			42	48	26	24	5		22	17					
Tiny Greenbul	*Phyllastrephus debilis*										1	2									
Common Bulbul	*Pycnonotus barbatus*						1		2										+		
Olive Thrush	*Turdus olivaceus*						1	1			2	8	4	16	4	5	9	14	15	12	19
Orange Thrush	*Zoothera gurneyi*				10	9									2	1					
White-chested Alethe	*Alethe fuelleborni*		6	12	8	9	2	9	2	12	30	18	23	21	2	1	8	2	3	16	14
White-starred Robin	*Pogonocichla stellata*					12	25	30			1	11	23	36	2	11	16	15	11	32	25
Swynnerton's Robin	*Swynnertonia swynnertoni*			2	3																
Sharpe's Akalat	*Sheppardia sharpei*			5	19	18	1				2	15	9	29	7	4	3	1			
Iringa Akalat	*Sheppardia lowei*					1		3													
Olive-flanked Robin	*Cossypha anomala*					3	7	24									8	28			
Red-capped Robin	*Cossypha natalensis*	43	49	12					3												
Cinnamon Bracken Warbler	*Bradypterus cinnamomeus*						13	17													
Evergreen Forest Warbler	*Bradypterus lopezi*				12	30	53	56			6	13	21	20	31	34	29	35	44	44	49
Yellow-throated Warbler	*Phylloscopus ruficapillus*			5			1	4			12	17	18	21	9	5	9	5	24	18	19
Yellow-breasted Apalis	*Apalis flavida*	4					1														
White-winged Apalis	*Apalis chariessa*					1	2														
Bar-throated Apalis	*Apalis thoracica*				2	4	13	9			2	6	26	21	10	10	20	41	8	15	31
Chapin's Apalis	*Apalis chapini*				1	3	14	12			2	13	18	9	15	32	11	7			
Black-headed Apalis	*Apalis melanocephala*		5	17	17	6		1	4	9	19	7	2		15	3	1		28	21	9
Brown-headed Apalis	*Apalis alticola*				1	1	2	1													

Species		Udzungwa Scarp							Ngurus						Ulugurus						
		540	800	1100	1340	1520	1780	2030	860	1070	1280	1550	1750	1950	1240	1480	1720	1930	1580	1780	2010
African Tailorbird	*Artisornis metopias*				4	6	22	15				1	1		5	7	13	23			
Mrs. Moreau's Warbler	*Bathmocercus winifredae*																6	3			
Bleating Bush Warbler	*Camaroptera brachyura*	48	32	10	5	1			19	9	6	1			5						
Dusky Flycatcher	*Muscicapa adusta*						1			1								1	2		1
Ashy Flycatcher	*Muscicapa caerulescens*			+																	
Lead-coloured Flycatcher	*Myioparus plumbeus*	10	3	2	1																
Forest Batis	*Batis mixta*	7	10	7	13	11	9	4	16	3	7	1			6	20	3	2	5	2	
Black-throated Wattle-eye	*Platysteira peltata*	4																			
White-tailed Crested Flycatcher	*Elminia albonotata*			2	6	8	12	13			4	14	16	12	15	25	42	20	19	18	35
Blue-mantled Flycatcher	*Trochocercus cyanomelas*	2		+					2												
Paradise Flycatcher	*Terpsiphone viridis*	2		2	5		10	13	5	17	40	22	9	1	7	16	9	9	19	1	
Spot-throat	*Modulatrix stictigula*				4	14	15	8				21	22	29	8	15	29	29			
Dappled Mountain Robin	*Arcanator orostruthus*				3	2															
Pale-breasted Illadopsis	*Illadopsis rufipennis*				3	1	3		7	6											
African Hill Babbler	*Pseudoalcippe abyssinica*					4	6	1									4	1	9	2	15
Uluguru Violet-backed Sunbird	*Anthreptes neglectus*	3			+																
Collared Sunbird	*Anthreptes collaris*	30	14	9	2	5	6	2	6	9	3				2				12	2	
Olive Sunbird	*Nectarinia olivacea*	24	44	41	60	46	25	14	57	76	78	71	32	12	42	12	1		72	73	58
Eastern Double-collared Sunbir	*Nectarinia mediocris*					3	22	5			1	18	50	63					21	26	39
Loveridge's Sunbird	*Nectarinia loveridgei*														19	39	47	93			
Yellow White-eye	*Zosterops senegalensis*				10	4	6	17			13	13	11	4	13	14	16	4			
South Pare White-eye	*Zosterops winifredae*																		10	33	38
Green-headed Oriole	*Oriolus chlorocephalus*								10	15	7	4			3	8					
Southern Puffback	*Dryoscopus cubla*	29	11	10	12	14	9	2													
Tropical Boubou	*Laniarius aethiopicus*	26																			
Fuelleborn's Black Boubou	*Laniarius fuelleborni*			1	17	32	34	47				1	11	15	9	20	26	33			
Uluguru Bush Shrike	*Malaconotus alius*														+	3	3	1			
Black-fronted Bush Shrike	*Malaconotus nigrifrons*		+	2	15	14	10	2		2	4	14	11	2	16	10	14	1	19	18	21
White-throated Nicator	*Nicator gularis*	40	22	30	6	2			19	4	1										
Square-tailed Drongo	*Dicrurus ludwigii*	28	25	39	34	21	1		18	19	17	10			22	9					
Waller's Red-winged Starling	*Onychognathus walleri*		10	13	5	7	4	6			3	4	4	4	15	9	23	4	69	33	6
Dark-backed Weaver	*Ploceus bicolor*	10	2	9	8	2	8	2		2	6	2			11	3					
Red-faced Crimsonwing	*Cryptospiza reichenovii*					1		3			2	3	19	15	2	1	17	5	3	3	4
Red-throated Twinspot	*Hypargos niveoguttatus*	1																			
Green Twinspot	*Mandingoa nitidula*	1			+					1					2						
Swee Waxbill	*Estrilda melanotis*						+	3													
Oriole Finch	*Linurgus olivaceus*																	1			

Probable Congo Bay Owl *Phodilus prigoginei* in Burundi

The type and only specimen of the Congo Bay Owl was obtained at Muusi in the Democratic Republic of Congo (03°04′ S, 28°48′ E, 2430 m) in March 1951 (Fry *et al.* 1988). A report of a probable second occurrence of the species, on Rwegura Tea Estate in Burundi, appeared in Collar & Stuart (1985), Fry *et a.l* (1988) and Butynski *et al.* (1997). We believe this refers to an unpublished observation made by ourselves in a different location and so decided to place the facts on record. PWPB communicated this observation to Leslie H. Brown in Nairobi in 1980, with the expectation that it would thus find its way into *The Birds of Africa*. However, Collar & Stuart (1985) apparently got incorrect data from another source and this was later quoted in Fry *et al.* (1988).

On 15 December 1974, in the forest near the tea plantation at Teza, Burundi (astride the Congo-Nile watershed, approx. 03°10′ S, 29°35′ E and 2500 m, some 25 km south of Rwegura and 85 km east of Muusi), at about 15:00 we were bird-watching along a well-trodden trail. LB spotted, with the naked eye, an owl perched on a branch about 3 m from the ground. It was very tame and allowed close approach, to about 2 m. We both saw the bird well but do not recall for how long we watched it before it flew away. It resembled a small Barn Owl *Tyto alba* and seemed to be about 25 cm in length. It had a buff, heart-shaped face with dark eyes, no ear tufts and a short tail. Upperparts were mottled red-brown and black, underparts buff spotted with black.

We had been along this trail several times during 1974 and went again on 1 January 1975 and several times during that year but did not see an owl on any other occasion. No pellets were observed on the ground.

The forest was on steeply sloping terrain and the trail entered the forest downhill from highland grassland. The distance of the owl inside the forest was not noted at the time. To our recollection it was not more than 100 m and may have been less. The forest consisted of mixed species of large and small trees with little underbrush. The canopy was dense. However, LB recalls seeing sky at the same time as seeing the owl, which may indicate that it was near the edge of the forest.

Since this observation was made there have been two other reports of the species: the call suspected to be of this owl recorded from the mountainous Nyungwe Forest in southwest Rwanda (roughly 85 km northeast of Muusi) in 1990 (Dowsett-Lemaire 1990); and one netted, and later photographed, about 50 m inside the forest at Kabembwe in the east of the Democratic Republic of Congo (03°52′ S, 28°56′ E, 1840 m), about 95 km south of Muusi in 1996 (Butynski *et al.* 1997).

The following factors make it almost certain that the bird we saw was a Congo Bay Owl: (1) habitat, consisting of montane forest and grassland, which is similar to that described in Butynski *et al.* (1997); (2) size; (3) heart-shaped facial disk; (4) lack of ear-tufts; (5) colour. The spots on the

underparts do not correspond to the published description of the single specimen of the Congo Bay Owl, in which the underparts are stated to be dark russet-cream with black streaks on the belly (Fry *et al.* 1988). However, they correspond exactly to the underparts of the Congo Bay Owl in the photograph in Butynski *et al.* (1997).

This species has had several English names. The observations in Burundi and Rwanda make the names Congo Bay Owl and Itombwe Owl inappropriate. Both observations were well outside the Itombwe forest. They were also outside the political jurisdiction of the Congo, and the Burundi bird was outside the catchment area of the Congo River, being on the east side of the Congo-Nile watershed. The forest here extends on both sides, as does the Nyungwe Forest in southwest Rwanda, which is located about 50 km north north-west of Teza along the same watershed. Either African Bay Owl or Prigogine's Owl would seem a more suitable name.

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Unusual behaviour of a White-naped Raven *Corvus albicollis* with its Superb Starling *Lamprotornis superbus* prey

While visiting Ngulia Safari Lodge, Tsavo West National Park, Kenya, at around 06:30 on 9 August 1996, we were observing two White-naped Ravens *Corvus albicollis*. The ravens were feeding on the remains of the goat carcass hung the previous night on a 6 m tall dead tree in front of the lodge, as leopard bait. A small group of Superb Starlings *Lamprotornis superbus* were foraging on the grassy area in front of the lodge terrace, 15 m from the dry tree. A 1-m high bird bath stood between the starlings and the tree.

One of the ravens suddenly glided down from the tree, and, alighting only briefly on the bird bath, flew immediately down onto a starling that appeared either unaware of the ravens, or unconcerned. Taking the starling in one foot, the raven proceeded to peck its head repeatedly in order to kill it. It then stepped back and warily circled the now slightly twitching corpse three to four times, pecking it once or twice more as if to ensure the bird was dead.

Once the starling stopped moving, the raven plucked a few feathers, seemingly trying to eat some of the flesh. It soon abandoned this and collected a few lumps of grass and earth, dropping them on the corpse in an ineffectual attempt to bury it. After about 5 minutes, the raven flew off and abandoned its prey.

Thirty minutes later, we saw a raven returning to the site. This was apparently the same bird, since it went straight to the corpse without hesitating. After some plucking, it severed the head from the body. Picking up the torso, the predator took a few steps, and buried the carcass under an isolated clump of grass. Going back to the head, the raven hid it amongst the blades of another clump of grass, paying no attention to it after that.

During the morning, the raven returned to the prey five or six times, at intervals of 2–90 minutes and unearthed, tasted, and re-buried it, sometimes in a different place. The furthest burial distance from the location of killing was 15 m, and the sites involved holes dug by the bird into the ground, under a grass tuft, a pile of dry elephant dung (twice), and in soft mud. Once the bird took the carcass to a small waterhole outflow, and dipped it several times into water before covering it with loose dry mud. The predator never tore at the body more than twice, and did not seem to eat more than a few morsels.

Eventually, the raven lost its prey to a group of Yellow Baboons *Papio hamadryas* that were passing through the area in the early afternoon, some eight to nine hours after the starling was killed. One of the juveniles in the group found the body and ate it, and a few minutes later an adult found and consumed the head.

The White-naped Raven not only eats carrion but preys on large insects, small mammals, and indeed anything it can overpower (Mackworth-Praed & Grant 1960), so the predatory behaviour observed is not unusual. On the other hand, there is no record of the behavioural sequence that followed. There are a number of possibilities why the bird might behave in this way. It may not have been particularly hungry as it had just been feeding on the left-over leopard bait. Having taken an easy opportunity to kill the starling, it then buried the prey for safe-keeping and later consumption. By burying and later moistening it, the raven may also have been improving the palatability of the starling — though there was no sign of the raven eating more of the corpse the last time it was unearthed.

Another possibility is that upon killing the starling, the raven suspected it to be diseased and therefore did not consume it immediately. More likely,

however, the raven would have discarded the starling altogether rather than cache it. The most feasible alternative is that this behaviour was the result of a taste aversion.

A negative correlation has been found between conspicuousness and taste in studies on European (Cott 1947) and African (Cott & Benson 1970) birds, using human taste perception as the criterion for palatability. These results were interpreted as suggestive of aposematic coloration. Direct evidence for such a relationship was detected in three brightly coloured New Guinean species of the genus *Pitohui* that are highly toxic (Dumbacher *et al.* 1992). Götmark (1994), however, re-evaluating Cott's (1947) and Cott & Benson's (1970) results, discussed some uncertainties of methodology and evaluation, suggesting that natural predators' reactions are the most reliable tests of the supposed aposematic effect. The Superb Starling was not amongst those tested for palatability, but its bright plumage makes it extremely conspicuous and it would therefore be expected to be correspondingly unpalatable. Our observations of the behaviour of the White-naped Raven indicates a taste aversion to the starling and convincingly reinforces Götmark's (1994) suggestion — at least for bird predators. Judging from the baboons' reaction, the edibility score for mammals may be different, underlining the concerns of Götmark (1994) regarding the evaluation of these traits.

Acknowledgements

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Long-toed Plover *Vanellus crassirostris* foot-stirring

From 20 October 1983 I spent a total eight days at Kosti (13°8′ N 32°43′ E) on the River Nile. The bird community here is described by Ewbank (1984). An embankment enclosed the river and its thick emergent vegetation. Tens of Long-toed Plovers *Vanellus crassirostris* were distributed throughout the vegetation, apparently in pairs on territories. No rails were seen and the only African Jacanas *Actophilornis africana* were on a pool outside the embankment. Hundred of Spur-winged Plovers *V. spinosus* were present in the nearby field.

Two Long-toed Plover pairs were accompanied by small downy chicks. With an incubation period of 30 days (del Hoyo *et al.* 1996), the estimated laying date is the week around September 10. This is the first record of breeding in the Sudan (Nikolaus 1987). Two birds were observed to hold one foot diagonal to the other leg and stir the water. This behaviour is believed to increase the rate of prey capture (del Hoyo *et al.* 1996). This appears to be the first record of foot-stirring in this species. Two other African lapwings, Blacksmith Plover *V. armatus* and Spur-winged Plover, have been recorded as foot-stirring in this manner either in aquatic or terrestrial situations (del Hoyo *et al.* 1996).

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Noteworthy Tanzanian bird records from the Field Museum of Natural History

During 1994, July 1997 and February 1998 I examined Tanzanian specimens in the collection of the Field Museum of Natural History (FMNH), Chicago. A number of distributional records came to light that were not reported by Britton (1980) nor (where within the geographical range that those authors covered) by Zimmerman *et al.* (1996). This note summarizes new information on the distribution of seven species in Tanzania.

Most of these records refer to material collected during the Conover-Everard African Expedition 1926–27, which comprised H.B. Conover, R.H. Everard and J.T. Zimmer (ARD 1927). The expedition team visited several areas of Tanzania and neighbouring countries, all of which are marked on a map lodged in the FMNH Bird Collection Division. The localities documented for specimens most likely conform to main villages or towns. They are Tabora, Tabora Region (5°01′ S, 32°48′ E), Mt Longido, Arusha Region (2°41′ S, 36°44′ E), Katungulu, Mwanza Region (2°31′ S, 32°40′ E) and Kilosa, Morogoro Region (6°50′ S, 36°59′ E). Despite much search in the museum archives, no information could be traced on more precise locations and habitats that the expedition team visited.

The number that precedes each species is taken from Britton (1980) to make reference easier. Nomenclature and taxonomy follow the more recent Zimmerman *et al.* (1996).

171 Hildebrandt's Francolin *Francolinus hildebrandti* While noting this species from several sites in northern Tanzania and from nearby south-central Kenya, Britton (1980) and Zimmerman *et al.* (1996) do not mention Mt Longido in northern Tanzania as a locality. Three individuals, two males and a female (FMNH nos. 413316, 413317, 413318), were collected by B. Cooper in March 1938 at c. 1350–1550 m on Mt Longido. These specimens appear somewhat intermediate between the nominate race and *altumi* but the series is too small to allow a definite conclusion.

221 Denham's Bustard *Neotis denhami jacksoni* Britton (1980) notes a few scattered records of this species from northwestern to southern Tanzania at Njombe. A female specimen (FMNH no. 405579) collected by H.B. Conover on 3 February 1927 at c. 1450 m from Tabora provides an additional locality. The exact site of collection is unknown: Tabora town is at the centre of a huge belt of miombo woodland, a habitat where this species is unlikely to occur.

422 White-faced Scops Owl *Otus leucotis* No specific mention of Morogoro is made in Britton (1980), but there is a record of this owl from nearby Dar es Salaam (N.E. Baker in OS-c 1984) and N.E. Baker (*in litt.*, 1997) ringed an injured bird in Turiani (close to Kilosa) during the mid-1980s. The specimen (FMNH no. 81579) from Kilosa, Morogoro, is an immature female collected on 31 October 1926 by J.T. Zimmer. Although labeled as ssp. *granti*, it more

resembles the nominate race in plumage. The immature plumage and a small comparative series prevented definite racial determination.

695 White-breasted Cuckoo-shrike *Coracina pectoralis* This taxon is reportedly scarce in northern Tanzania (Zimmerman *et al.* 1996). A male specimen (FMNH no. 81953) from Katungulu, Mwanza, collected on 26 February 1927 at c. 1200 m by J.T. Zimmer, therefore provides an interesting new location. The closest known localities of this species to Katungulu are Ngara and northern Tabora region, both approximately 200 km away to the west and south, respectively (Britton 1980).

771 Sooty Chat *Myrmecocichla nigra* Britton (1980) predicted that this chat should occur in the area south of Lake Victoria. Fuggles-Couchman (1984) confirmed this with records from Geita, southwest of Mwanza, in July 1957. Zimmerman *et al.* (1996) also note it from the Masai Mara National Reserve in Kenya and the adjacent northern section of the Serengeti National Park, Tanzania. Four specimens, two males and two females (FMNH nos. 81826, 81827, 81828, 81829, February 1927, c. 1200 m, *leg.* J.T. Zimmer), from Katungulu, Mwanza, must be added to these records.

930 Semi-collared Flycatcher *Ficedula semitorquata* A pair (FMNH Nos. 81767, 81768, 24 February 1927, c. 1200 m, *leg.* J.T. Zimmer) from Katungulu, Mwanza, provides the first record from northern Tanzania (Britton 1980, Zimmerman *et al.* 1996). However, this flycatcher is reported from the nearby Masai Mara National Reserve, Kenya (Zimmerman *et al.* 1996).

1051 Ashy Starling *Cosmopsarus unicolor* The Ashy Starling is endemic to the interior of Tanzania (Britton 1980, Zimmerman *et al.* 1996). Although known east of Ngorongoro, it has not been reported from the Serengeti (Baker 1990). Britton (1980) mentions an old record from Lake Jipe in southeast Kenya which Baker (1990) refers to as "supposedly taken from Taveta", implying that there is some dispute as to the exact locality of this specimen (see Zimmerman *et al.* 1996). The specimen in question is in the FMNH collection (FMNH no. 198862, female, 2 April 1917, Kilimanjaro, coll. V.G.L. van Someren). Zimmerman *et al.* (1996) state that this starling once occurred in the lowlands around Mt Kilimanjaro, but there is no evidence that lends support to this idea except for this controversial specimen. Turner (*in litt.*, 1996) notes that van Someren's collectors, who chiefly collected in the Taveta and Voi areas, placed the specimens on the railway and sent them to him from these locations. Thus the locality data for many of these specimens, including the Ashy Starling discussed here, are of questionable validity. It seems very unlikely that this starling ever occurred in the Kilimanjaro area, given our current knowledge of its distribution patterns in Tanzania (Baker 1990).

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Black-faced Red-billed Hornbills *Tockus erythrorhynchus* in Ruaha National Park, south-western Tanzania

Kemp (1992) reported seeing a pair of captive black-faced Red-billed Hornbills *Tockus erythrorhynchus* in Singapore in 1989, but was unable to establish their place of origin. Subsequently he found some specimens of *Tockus e. erythrorhynchus* in the British Museum, collected in Senegal and Gambia, that were black-faced with brown eyes. In the Berlin Zoologische Museum specimens from Tanzania around Lake Rukwa and northward to Lake Victoria were also black-faced but with yellow eyes. In the National Museum, Nairobi, there are also two black-faced specimens. One, no. 8487, was collected from Lake Rukwa in 1938 and the other collected on 12 November 1961 from the Nyangwa River 10 km south-east of Tabora. The latter specimen has no National Museum identification number, but the collector's (Louisiana University Museum of Zoology) number is 5350/498. The material in these three museums has been overlooked in all recent work, including that summarised in Fry *et al.* (1988).

All individuals of *Tockus erythrorhynchus* that we have seen in Ruaha National Park between 1994 and 1998 are black-faced. In adult birds the bare circumorbital skin is black, while that in the gular region is translucent white. The iris is yellowish white. In birds less than five months old, the circumorbital skin is greyish-white with small intrusions of black, the gular skin is greyish-white and the iris brown. We have never seen any birds in Ruaha with the yellow circumorbital and gular skin and brown eyes reportedly typical of *Tockus e. erythrorhynchus* — the race with which we are both familiar in eastern Kenya and north-eastern Tanzania.

Black-faced Red-billed Hornbills are common in Ruaha and we have recorded them in most components of the park's vegetational mosaic, including *Brachystegia* woodland, *Acacia* and *Combretum* woodland and riverine forest. We have observed breeding in January, February and March. Females are walled into tree hollows in the manner typical of the *Tockus* genus. Male displays include partially spread wings and head bobbing that is, superficially, similar to that we have seen in *Tockus e. erythrorhynchus*.

Ruaha lies between Lakes Rukwa and Victoria, though somewhat to the east of a line between them, and thus in the zone of western Tanzania that yielded the black-faced specimens in the Zoologische Museum. Our observations confirm that such birds exist uniformly as local populations and to the exclusion of birds typical of any of the three described sub-species of *Tockus erythrorhynchus*. These are nominate *erythrorhynchus* and the more southerly *rufirostris* and *damarensis*, none of which has black faces.

The long over-looked black-faced Red-billed Hornbills of Ruaha and western Tanzania generally may be worthy of at least sub-specific recognition, and might warrant specific status. We endorse Kemp's 1992 call drawing attention to this possibility, and requesting ornithologists to record all and any data on black-faced Red-billed Hornbills to establish their true status. Finally, we note that Tanzania has a substantial legal and illegal trade in wild birds for the aviculture business. Consequently it would not surprise us if the birds Kemp saw in Singapore in 1989 came from Tanzania.

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Use of clearings by Humblot's Flycatcher *Humblotia flavirostris*

Humblotia is the only bird genus endemic to the Comoro Islands. Its sole member, Humblot's Flycatcher *H. flavirostris*, is restricted to the forest and higher-altitude *Philippia* tree-heath zones of Mont Karthala on Ngazidja (Grande Comore). It is common in the forest interior (Benson 1960) and in pure stands of heath neighbouring but above the forest belt (Louette 1988), also occurring in open pioneer woodland on lava flows (Herremans *et al.* 1991). Louette (1988) noted that it frequents the middle storey, perching relatively low in the vegetation, and it is most active in the morning and evening, feeding on insects by ambushing or catching them in flight. Whilst heath and pioneer woodland are more open-canopied habitats than forest, *Humblotia* has not been recorded from open country.

At dusk on 20 June 1992, I saw at least two *Humblotia* persistently feeding in a large clearing. I had climbed through the Karthala forest during the morning, seeing or hearing 10 *Humblotia* in typical habitat, and arrived at 13:00 hrs at the mainly grassy clearing at La Convalescence, which is over 400 m across and at 1,700 m above sea level. Two more *Humblotia* were calling from the forest interior close to the clearing. Until this time, all behaviour seen was typical of that described for the species. Then, near dusk, two *Humblotia* began sallying into the clearing from trees at the edge. As the light faded, they landed in bracken *Pteridium aquilinum* in the clearing, where they perched on top of fronds, twitching, and giving the usual trilled call described by Safford & Evans (1992). One also used a terminal inflorescence at the very top of an isolated tree (probably *Cussonia* sp. – Araliaceae) in the clearing, at least 100 m from the forest edge. Between bouts of prominent perching, the birds returned to the forest edge. The behavioural similarity to Stonechats *Saxicola torquata* (also present) was very striking, but the views were good enough to distinguish the two species easily. After sunrise the next morning, no *Humblotia* were seen in the clearing.

Humblotia is dependent on forest, and is absent from the extensive grasslands of much of Ngazidja. However, this observation shows that it uses cleared areas within intact forest in a manner quite out of character with its previously documented behaviour, at least at certain times. No prey capture was seen, but foraging is the most likely explanation. Use of the clearing was only seen near dusk, and so it seems possible that the birds only emerged from the forest when the light level in the clearing was similar to that in the forest during the day.

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Observations on the White-throated Rail *Dryolimnas cuvieri* in Madagascar

Despite the Rallidae being one of the most widespread families of terrestrial vertebrates in the world, basic ecological information is lacking for many species because of their secretive behaviour. The White-throated Rail *Dryolimnas cuvieri* is represented by a flightless sub-species *D. c. aldabranus* on Aldabra and the nominate *D. cuvieri* in Madagascar (Taylor & van Perlo 1998). Although the *D. c. aldabranus* population is currently considered stable (Barry Taylor, pers. comm.), it has recently undergone a decline in distribution (Hambler *et al.* 1993) and has been considered globally Rare (King *in* Collar & Stuart 1985).

Most published information on food and feeding, social organisation and behaviour has come from *D. c. aldabranus* (e.g. Penny & Diamond 1991; Hambler *et al.* 1993). Therefore, although widespread throughout Madagascar in a variety of different habitats (Langrand 1990), there is very little information on diet, breeding and behaviour of the nominate *cuvieri* (Taylor & van Perlo 1998). In this short note I report on a series of observations on a family group of *D. cuvieri* made during December 1997 in Madagascar.

Observations were made between 4 and 12 December 1997 in mid-elevation (GPS reading 1365 m), moist evergreen forest at Andranomay (near Androzorobe), eastern Madagascar. The family group consisted of two adults and four black, downy chicks. All sightings were made within 20 m of a research camp site which was adjacent to the Sahavilhana river (width c. 3–4m).

Adults were observed foraging in the river and on the forest floor. Within the river, the birds favoured riffle areas and margins, although this preference for riffle may have been related to the presence of food particles from the nearby encampment. Nevertheless, the birds demonstrated an ability to wade and forage in the river and were frequently observed turning stones and probing in sandy areas irrespective of the presence of camp waste.

Furthermore, the apparent preference for riparian habitat was shown both up and down stream of the encampment, thus indicating the habitat selection to be representative of natural conditions. Whilst foraging in the river margins, they also picked prey off large boulders and over-hanging vegetation. Terrestrial foraging was also common and birds probed areas of soft, bare mud, picked from mossy logs and turned leaves. In a small open area, adults were observed chasing and catching tiger beetles (Cicindelidae). On one occasion, an adult was seen swimming to the chicks with a fully grown, arboreal chameleon *Calumma gastrotaenia* in its bill.

The chicks did not actively forage and remained hidden in riverside vegetation whilst the adults collected food. Numerous crab carapaces were found in the area frequented by the chicks.

The birds were rarely observed more than 3 m from the river, but this could have been because of dense ground vegetation associated with the riparian margin. White-throated Rails were reported to be locally common in the wooded river valleys, but were absent from the slopes and ridges (Samuel Rakotondrajemy *pers. comm.*).

The observations from Andranomay are consistent with those of *D. c. aldabranus* on Aldabra, which also fed in shallow water and leaf litter, and included crabs and beetles in its diet (Penny & Diamond 1971). In Madagascar, Taylor (1996) reported *D. cuvieri* foraging in streams and Langrand (1990) reported a diet consisting chiefly of invertebrates. However, given the observation of a small chameleon in the diet and the diverse and abundant herpetofauna typical of Madagascar's forests (Raxworthy 1988), it is conceivable that reptiles constitute an important part of the diet. Chameleons in particular may be preyed on, and have been recorded in the diet of other bird species, particularly the endemic vangas and birds of prey (Langrand 1990). Based on the foraging methods observed in this study, the *Brookesia* (dwarf chameleons) would be potential prey items because they are mostly terrestrial and rarely found above 1 m (Raxworthy 1988). Furthermore, the high density of *Brookesia* (110.2 ± 19.8 (s.e.) ha^{-1}) in the riparian forest at Andranomay (Brady & Griffiths 1998) suggests that they should have a high encounter rate with forest rails. However, more research is needed to determine the behavioural and physiological defence mechanisms of chameleons and the extent to which White-throated, and other forest rails, include chameleons in their diet.

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Omission: Sighting of White-collared Kingfisher *Halcyon chloris* in south-central Somalia

In the note by Tony Potterton in *Scopus* 20 (1998), p. 56, the date of the observation of White-collared Kingfisher at Warsheikh, Somalia, was omitted. This was 20 April 1997.

Information requested: Tanzanian localities in Britton (1980) for Kenrick's Starling *Poeoptera kenricki*, Iringa Akalat *Sheppardia lowei*, Ethiopian Swallow *Hirundo aethiopica* and Southern Rock Bunting *Emberiza capensis*

While compiling data for the Tanzania Bird Atlas I have come across several references in Britton (1980) to species and localities that are not given any original reference. I would much appreciate the assistance of the *Scopus* readership in answering the following.

Mdando FR (Njombe) is given as a locality for Kenrick's Starling *Poeoptera kenricki* and Iringa Ground Robin *Dryocichloides lowei* (now named as Iringa Akalat *Sheppardia lowei*). The original publication reference, name of observer or collector and dates are required. Mdando is not included in the gazetteer in Britton.

The Ethiopian Swallow *Hirundo aethiopica* is stated to occur in Masasi, south-eastern Tanzania. This is such an unlikely locality for this species that the original reference is being sought to clarify the record.

The account for the Southern Rock Bunting *Emberiza capensis* reads as follows: "The race *vincenti* is a locally common resident of rocky, boulder-strewn hills at medium elevations in Songea, SE Tanzania, often associated with patches of xerophyta. There are records from several localities (north to Litembo)." Despite the explicit nature of these comments I have failed to trace any written record of this species from Tanzania. It is not known to occur in northern Mozambique (admittedly a poorly known area) or in northern Malawi. These records therefore represent a considerable extension of range and as this is the only record for East Africa I feel it should be properly documented.

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Tanzania Bird Atlas, P O Box 9601, Moshi, Tanzania, e: kifufu@eoltz.com

Urban, E.K., Fry, C.H. & Keith S. (eds) 1986. *The birds of Africa.* Vol. 2. London: Academic Press.

Both English and scientific names of birds should be given when the species is first mentioned — in the title and in the text — thereafter, only one name should be used.

Bird names should be those of a stated work. Any deviations from this work should be noted and the reasons given.

Contributions should be submitted on paper (two copies) and simultaneously on disk or by e-mail, as a file in Rich Text Format (RTF). Manuscripts should be typed in double-spacing on one side of the paper only, with wide margins all round. Original black-and-white photographs and line illustrations should not be larger than A4 (210 x 297 mm). Line illustrations should be on good quality white paper or board, or on tracing material, with lettering of professional quality (if this is not possible, label an overlay, not the original figure). Copies of graphics as separate electronic documents (files) in TIFF or EPS format are appreciated.

Authors of 'papers' receive five copies, and authors of short communications one copy, of their contribution *gratis*. Extra copies, charged at cost, must be ordered when the MS is accepted.

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Rare birds in East Africa

Records of rare birds from Kenya, Tanzania and Uganda are assessed by the East African Rarities Committee. Initially, a full account of the record should be sent to the Committee's co-ordinator, Colin Jackson, Mwamba Bird Observatory, P O Box 383, Watamu, Kenya, tel. +254-(0)122-32037, e: colin.jackson@bigfoot.com .

Ringing scheme of eastern Africa

This covers several countries in the area. Qualified and aspiring ringers should contact the ringing organizer, Graeme Backhurst, P O Box 15194, Nairobi, tel. +254 (0)2 891419, e: graeme@healthnet.or.ke.

EANHS Nest Record Scheme

Details of most kinds of breeding activity are welcomed by the scheme and nest record cards may be obtained free of charge from the Nest Record Scheme organizer, EANHS, P O Box 44486, Nairobi, e: office@naturekenya.org

The BirdLife International Partnership in eastern Africa

The BirdLife Partnership in eastern Africa co-ordinates bird conservation work and produces several other publications of interest to ornithologists.

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Wildlife Conservation Society of Tanzania • P O Box 70919, Dar es Salaam • Tel: (+ 255 22) 2112518/2112496, fax 2124572 • e: wcst@africaonline.co.tz